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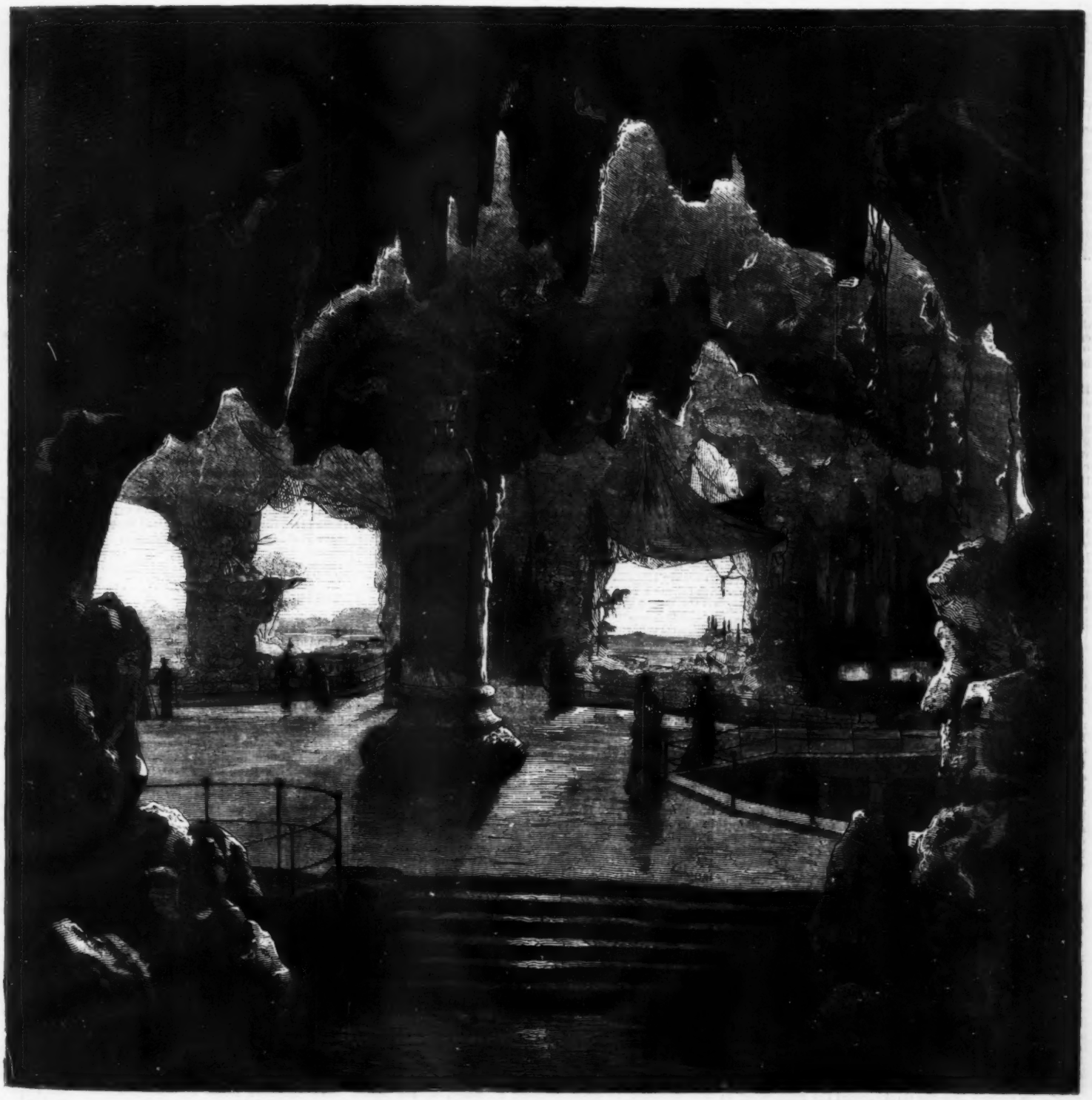
INTERNATIONAL FISHERY EXHIBITION, BERLIN.

It speaks very highly for the taste of the directors of the International Fisheries Exhibition that they have not limited themselves to the arrangement of a handsome show of all the products of the ocean and the means of obtaining them, but have also endeavored to present the beauties of the ocean, its grottoes, shores, etc. That these endeavors were crowned with success will not be disputed by any person that has had occasion to visit the grotto they ordered to be built, and which is represented in the above cut, taken from the *Leipziger Illustrirte Zeitung*. It is a representation of the ideal palace of the mighty king of waters, Neptune, and is built of stalactites of the most mysterious forms. The ceiling, consisting of the same material, is supported by a strong central column. The side walls of the grotto are provided with several large openings, through which the visitor gets a glance at the beautiful paintings by Wilberg, representing the scenery of the Gulf of Naples. In our cut Vesuvius is shown in the rear at the left hand side. Large glass tanks are built into the walls of the grotto, and contain the various species of fish found in the waters of Germany, and also among others the male eel exhibited by Dr. Hermes, of the Berlin Aquarium.

A correspondent of the New York *Times*, writing from Berlin, June 2, says: Although several weeks have passed since the opening of the great Fishery Fair, Berlin is still apparently as much interested in it as ever, judging from the numbers which daily attend it, and which have ranged from between 5,000 and 6,000 to above 17,000, the largest attendance being on Sundays. The price of admission is placed at one mark (24 cents) between the hours of 8 and 11 A.M., and at half that sum from 11 A.M. to 7 P.M. This arrangement allows those who are present for study to fulfill their purpose free from the presence of the crowd. During the first portion of the day the attendance is composed mainly of gentlemen, who examine the articles more or less critically; many of these persons have come from England, France, Italy, and other countries with this object in view. Mr. Walpole, Inspector of Fisheries of Great Britain, has already been here several weeks. The attendance will, perhaps, average 2,000 persons per day, rising on Whitsunday to about 30,000, 24,789 tickets having been sold at the doors, besides an estimated number of 5,000 disposed of by the street car companies, no returns of which have yet been made.

The American exhibit is everywhere spoken of as one of great merit and importance, being larger than that of any other country in its variety, if not in the number of specimens. The great beauty of the collection sent by the National Museum and the Irish Commission consists, in fact, chiefly in its variety, and in the absence of duplicates, which only serve to weary the sight-seer and student. This collection comprises the mammalian carnivora of the land



THE INTERNATIONAL FISHERY EXHIBITION, BERLIN.—NEPTUNE'S GROTTO.

and water, including the fisher, mink, otter, raccoon, seals, cetaceans, etc., which feed upon fish; the piscivorous birds, which are destructive to either fish or their eggs, from the water-ousel, crow, king fisher, eagles, herons, fish-eating ducks, pelicans, gannets, gulls, to the loons and grebes; reptiles, as alligators, turtles, and water-snakes; and destructive fishes, from the great sharks to the rapacious gar of fresh water. These, as well as the food fishes, are well shown in the admirable plaster casts of the National Museum, and also by colored plates and photographs.

Mr. B. J. M. Carley, of Fulton Market, New York, has furnished, through Mr. E. G. Blackford, a series of oysters from the vicinity of New York, which illustrate the peculiarities of the favorite "brands" that delight the palates of New Yorkers. The barrels of fresh oysters received met with a warm reception in this land, where oysters are worth $1.50 a dozen; while the last report of the Maryland Fish Commission, containing the life, history, and a series of illustrations of the embryology of the American oyster, prepared by Dr. W. K. Brooks, of Johns Hopkins University, Baltimore, is eagerly sought for by the naturalist and the oyster culturist. The latter finds in this report innumerable facts not only new, but diametrically opposite to what is recorded in the history of the European bivalve.

The great fishing countries are Norway, Holland, and the United States—that is to say, these are the countries which catch more fish than they consume, and, consequently, are rivals for the export trade. France catches about what she consumes, and exports little save sardines and what may be called fishes of luxury, while England and Germany are great consumers. The dry-salted preparations include codfish in all its forms and also "abalone," the venus-ear (*Haliotis*), which is cured in Santa Barbara, Cal., and sent to China in large quantities, as well as "whale-sinew," which finds a market in the same country. The smoked preparations include halibut, herrings, eels, smelts, haddock, shad, bluefish, mackerel, salmon, and sturgeon; while there are many exhibitions of fish in pickle as well as in spice and vinegar, oil, etc., from the factories of the Atlantic coast. The cooked preparations in cans are well represented by "codfish balls" (this does not translate well into German), fresh codfish, haddock, cusk, canned fish chowder (also not translatable), mackerel of many sorts and styles, halibut, salmon, smelts, terrapin, lobster, shrimps, hard crabs, deviled crabs, clams, clam chowder, oyster, and "extract of fish," the latter being shown by seventeen different firms or companies, not counting a few entries by the Fish Commission, the largest exhibitors being H. K. & F. B. Thurber, of New York. Many of these articles are entirely unknown in Europe, especially the American clam, the jury insisting upon passing them as "mussels!"

It is said that the awards will not be made public until the close of the exhibition. In consequence, it is impossible to give a guess as to the direction which the prizes will take. Nevertheless, it would not require a prophet to foresee that the clam, which is such a favorite on Coney Island, will not carry off the honors in Europe, where it is simply a "mussel," and "clam chowder" is an unknown mixture, to be regarded with suspicion.

A consignment of fresh fish is received weekly from Mr. E. G. Blackford, of Fulton Market, and the American striped bass is much admired, so much so that there is a proposition to introduce it into German waters. The fish are placed in a refrigerator and can be seen through the glass. Mr. Blackford being either fortunate in regard to weather, ships, or other influences, or else systematically careful in his packing. Whether luck or skill, it is certain that his specimens have come over in very good condition and make a creditable display.

It is commonly said here that the complete and exhaustive exhibition of American fisheries will stimulate emigration, few persons here having an idea of their extent and value. Had it not been made a national affair, and placed in the hands of Prof. Baird, the United States Commissioner on Fish and Fisheries, with the National Museum and the Fish Commission to draw upon, the collection could not have been gotten up in its present condition and completeness under five years. As it is, the whole display, excepting the canned goods, a few boats, and the paintings, came from the Museum at Washington, and was ready for shipment in three weeks from the time when Congress wisely decided that the great American fishery interests should be brought forward prominently at the present International Exhibition, in order that our productions might be carefully examined by the consumers of the world. The exhibit of American anglers' goods is exceedingly large, including rods, reels, flies, hooks, and lines of all sizes and qualities. But, although it is so extensive, and comes from so many different makers and firms, it is all the property of the National Museum, and is so exhibited, with the makers' or dealers' names and addresses on the bottoms of the cards, the only exception being in the case of split bamboo rods sent by H. L. Leonard, Bangor, Me. This department is very complete, and is shown by the side of the Smithsonian collection of savage implements, forming a striking contrast to the bone and wooden hooks, sea-weed and walrus-hide lines, etc., which delight the man of ethnological tastes.

The interest in angling material is not great, and, perhaps, no one has come to Berlin especially to study it. From the number of people who make inquiries concerning any special department, an estimate may be formed of the value of the different exhibits, which would seem to be in this ratio: Canned goods and other food preparations, fish-culture, nets, boats, and appliances used in the fisheries, natural history, and, lastly, the fishery products used in the arts and manufactures. All of these classes are subdivided into many parts, and if we consider that the number of inquiries relating to canned goods and food preparations is vastly increased by the number of casual visitors who are suddenly seized with a desire to open a business in this line by selling on commission, but who never do so, it would then seem as if the culture of fishes as a means of increasing the food supply was the subject which attracted the attention of the thinking visitor in the highest degree. The visitors may rightly be classed into the thinking and the unthinking in the proportion of ninety-nine of the latter to one of the former. It is noticeable that the students of fish culture as a class are men who have the welfare of their lands at heart, and are often those who have not only inclination but power to encourage this peaceful and profitable industry. Prominent among these men is the Crown Prince of Germany, who takes great interest in fish culture as a means of feeding a people whose land cannot produce much more beef, pork, or mutton than it does at present, but whose waters may be made to yield more than they have ever done. His questions show that he has more than a superficial knowledge of this subject.

It is generally conceded that in improved apparatus for fish culture the United States is far ahead of other nations. The models of the new hatching steamer Fish Hawk are always the center of attraction and admiration, especially the large sectional model, on a scale of one-sixth. This idea of a floating hatching house at once strikes the fish culturist as something very practical, inasmuch as it can be taken from one fishery to another as required, while the eggs may be obtained from wherever they may be in the greatest abundance without packing or transportation.

American fish culture is well represented at Berlin by the United States Fish Commission—which shows models of all American fish-ways—some twenty in number—devices for obtaining and impregnating ova, models of hatching-houses, hatching troughs and boxes, both stationary and floating, devices for transporting live fish and eggs, accessories to hatching apparatus, apparatus used in feeding fry, maps, charts, and the literature of fish culture, enemies of the fish culturist, eggs of fishes in alcohol, etc., probably the most complete and exhaustive display of the kind ever attempted.

The New York Fish Commission also makes a display of the apparatus used in the hatching of the salmonidæ, shad, and white-fish, devices for changing water, eggs in alcohol, reports, and hybridized fishes.

Among the private fish culturists who exhibit through the United States Commission may be named the veteran, Dr. Garlick, who sends a model of the trout hatching box used in his first experiments. Mr. James Annin, Jr., trout-breeder, of Caledonia, N. Y., sends a model of box used in shipping eggs to Europe, which has been found to be very effective. Mr. S. H. Ainsworth, another fish-cultural pioneer, exhibits the model of his unpatented spawning race, whereby the fecundated eggs may be taken from the stream after being deposited by the parent trout, a very useful contrivance when the fish are not in numbers sufficient to make it profitable to strip them by hand. The Maryland Fish Commission sends a model of the "Druid Hill Hatching House," which is located in Druid Hill Park, Baltimore, one of the most complete establishments in the country, built in 1875 by the City of Baltimore, under the direction of Major T. B. Ferguson, State Commissioner of Fisheries, at a cost of $7,000. The model is a working one, and was shown at Philadelphia, with water running through it. On the floor of the house are models of the Ferguson jars, flights of Coste rays, troughs of Williamson's patent, hatching boxes of Clark's patent, same of Holton's, aquaria, reservoirs, and porcelain-lined sinks. The Fish-cultural Department of the United States is also rich in maps, photographs, and charts, prominent among which may be mentioned maps of the national carp ponds at Washington, D. C., and the Druid Hill carp ponds at Baltimore; map of the United States reservation for fish-cultural purposes on the McCloud River, California, and a map of the United States Salmon-breeding Works at Grand Lake Stream, Maine, as well as photographs of the hatching stations, the Fish Hawk, and apparatus, making a collection which at once strikes the observers as complete and really unsurpassed.

There is a family resemblance between most of the nets, lines, and other appliances used for taking fish on both sides of the Atlantic, the differences being only such as are caused by the expense of the raw material, individual or national preference, etc. But there is on each side one distinct form of net in use which could be adopted on the other side with great advantage; these are the "beam-trawl" of Europe and the "purse-seine" of America. The beam-trawl is the best known device for taking the bottom fishes, especially the flat fishes, which habitually lie upon the bottom, and only leave it for a moment to change their location as the impulse seizes them. They often bury themselves in the sand, with only the head and breathing apparatus exposed, and there watch for food or enemies. The beam-trawl is dragged along with its beam connecting two supports, depending from which is the bag-like net, the upper portion being fast to the beam, while the lower is weighted with leads that drag the bottom. This makes a capacious maw some 25 feet in length and 2 feet in height, into which the startled fish escape for protection. It is by this mode of fishing that all the famed turbot and soles are caught, and it is practiced by the fishermen of England to a great extent for flounders, brill, and other bottom fish, even the shrimp-netters using a smaller contrivance of the same pattern to capture their prey. The beam-trawl is dragged by lines, varying in length with the depth of water, at a speed of three to six knots an hour, the trawl being left down from one to four or five hours, according to the depth, speed with which it is dragged, etc. This form of fishing has never been utilized in America, except in the investigations of the United States Fish Commission, where it was productive of most valuable results in bringing to light new species of fish and forms of life unknown to science. In the discovery of the "craig," or "pole-flounder"—*Glyptocephalus cynoglossus*—a fish which is said to equal the finest of European flat fishes, it has proved to be of inestimable value; this fish has lived upon our coast no man can say how long, and was caught in quantities that proved it was plentiful, and yet our oldest fishermen had never seen one! Lo! here comes a government steamer having on board a corps of scientists, with Prof. Baird at their head, and, on dropping this "new-fangled" contrivance, they bring up dozens of "new" fish, the like of which no American fisherman had ever seen, but which, upon a careful examination, turn out to be a favorite European fish not known to exist on the western side of the Atlantic. The apparatus used in America, which is attracting attention in Europe, is the "purse-seine," a species of seine used in the herring and menhaden fisheries. When a school is surrounded, this seine purses up at the bottom by means of a weight dropped overboard, and prevents the escape of the fish under the lead-line.

AWARDS TO AMERICANS.

BERLIN, June 17.—The prizes to the successful exhibitors at the International Fishery Exhibition were distributed today. It is understood that the governments to which it is proposed to send a gold medal with an address of thanks include that of the United States. The first honorary prize was awarded to Prof. Spencer F. Baird, of the Smithsonian Institution, Washington.

Among the awards are the following gold medals, with special honorary mention: The United States Finance Department and United States Fisheries Commission. The following exhibitors have received gold medals: United States Fisheries Commissioners Leonard, of Bangor, Me.; Atkins, of Rockport, Me; Ferguson, of Baltimore, Md.; Green, of Rochester, N. Y.; Donald, of Lexington, Va.; Mather, of New York; Stone, of Charlestown, N. H., and Chase, of Detroit, Mich. Silver medals were awarded to the Alaska Commercial Company, of San Francisco; the Beardsleys, of New York; Booth, of Chicago; Porter & Wrightington, of Boston; the Portland Packing Company; the Russia Cement Company, of Rockport, Mass.; Rosenstein Brothers, of New York; Thorne, of Massachusetts; Thurber, of New York; Ward, of America; Hagedorn, of New York; Everson, of Brooklyn, N. Y.; Wilcox Crittenden, of Middletown, Conn.; Chase, of Detroit, Mich.; Merriman, of New York; United States Fisheries Commissioner Brown Goode, of Washington; the *Forest and Stream* Publishing Company, of New York; Noble, of Richibucto, Canada, and Scribner, of New York. A large number of Americans received bronze medals, diplomas, and honorary mention.

AMERICAN BACON AND PORK.

THE hogs of the United States muster 35,000,000, or nine times the number enumerated in the United Kingdom. The abundance of the Indian corn crops of the past few years has stimulated their production at the rate of 1,500,000 per annum. They quickly convert the corn and oats, worth about 1s. per bushel, and grass, clover, and other cheap, bulky, unsalable vegetable food, into the salable animal which readily run to market. The State of Illinois makes a muster of 3 1-3 million pigs; Iowa and Missouri each have nearly 3,000,000; Indiana and Kentucky each contribute 2,000,000; Berkshire and Fisher Hobbs Essex, large and middle-sized whites, and a useful China hog are used. All are well-grown and profitable. I did not see a thriftless pig while in America. Abundance of room and exercise, with varied food while growing, develops size and more lean meat than is exhibited among our more artificially managed, closely confined grunters. As at home, the contagious fatal hog cholera occasionally occurs, spreading from the great markets to the premises of breeders and feeders, and sometimes causing great losses. The average value of the American hogs set forth in the agricultural statistics for 1878 is only 15s. 9d.; but in Colorado and other territories they reach 30s., and in Massachusetts amount to 45s. 9d. Although of small individual value, the American farmers' capital in hogs represents a total aggregate of £22,000,000! In summer on grass and clover, finished off with corn in winter among the cattle in the yards, these hogs are cheaply reared and fed. They are sold at ages varying from six to eighteen months, at weights ranging from 100 lb. to 300 lb. The heaviest are brought out in winter; the cheaper summer-fed sometimes fall as low as 1¼d. per lb. gross weight. But so small is the outlay in their upbringing that even at this low figure some profit is earned.

A few hogs are slaughtered and salted by the farmers, but the great bulk pass to the packers. This is one of the special and prosperous industries of the States, commenced with small beginnings some twenty-five years ago, and rapidly growing with the greatly increasing demands for exportation, which now absorbs sixty per cent. of the American hog products. Until within recent years, much of the bacon and pork was salted and packed in barrels, but now it is chiefly distributed throughout the States in bulk and in boxes; throughout Europe entirely in boxes. Formerly hog slaughtering was conducted only during the winter months. Now, with abundant supplies of cheap ice, about 5,000,000 hogs are slaughtered, or nearly half the packing is overtaken during the summer season from the first of March to the first of November when vegetable food is abundant and the pigs can be quickly and cheaply fatted. Excepting in price American bacon cannot compare with the best Irish, Wiltshire, or Yorkshire, but it is steadily improving. Were the hogs finished off as they might be with a daily meal of barley, instead of all corn, the bacon would doubtless be firmer and less liable to shrink when cooked. It is not so fat as good English or Irish bacon; it is better boiled than grilled; when grilled it is apt to waste, and some of it also emits a peculiar flavor.

The subjoined table exhibits the number of hogs packed in three great divisions of the United States during each of the three years ending the first of March:

	1876-77.	1877-78.	1878-79.
The West.....	7,409,174 ..	9,048,566 ..	10,858,692
The East	2,551,239 ..	2,703,670 ..	3,222,011
The Pacific Slope,	305,000 ..	310,000 ..	400,000
	10,265,413	12,062,236	14,480,703

Canada packs about 200,000 hogs. The total annual hog products turned out by packers throughout the States now exceed 25,000,000 cwt., and are increasing yearly at the rate of about seventeen per cent. The average weight of the pigs killed in 1878-79 was 217·14 lb.; their average cost, net weight, per cental, was $3.56, or 50 cents less than the average price for the previous year, and only a little over half the price of 1876-77. Tempted by such low prices, packers have everywhere enlarged their business. At many convenient points throughout the West new establishments have been opened. Stocks of bacon and pork during the earlier parts of last year accumulated to the extent, it was estimated, of £100,000,000. It seemed as if the supply had outrun the demand. The good harvest in the West increased, however, the home demand for hog products, as for so many other things; the export demand also increased; prices advanced; and surplus stocks have been cleared off, the United Kingdom paying for her annual proportion nearly £10,000,000 sterling.

As above indicated, about two-thirds of the American hog packing is done in the West; seventy per cent. is overtaken in the six cities of Chicago, Cincinnati, St. Louis, Milwaukee, Louisville, and Indianapolis; more than half are handled in Chicago, where during the past year 7,000,000 hogs have been concentrated, and 5,000,000 slaughtered. There are in Chicago about twenty-five houses employed in this business. The three principal, disposing among them of 2,500,000 hogs annually, are Messrs. Armour & Co., the Chicago Packing and Provision Company, and Messrs. Fowler Brothers. Messrs. Armour & Co. handle nearly 1,000,000 hogs annually at Chicago, and have similar establishments at Milwaukee and at Kansas City, at each of which upwards of 400,000 are slaughtered and packed. From small beginnings in 1860 their business has steadily increased; within six years it has doubled. At the Chicago works at the stock-yards, 10,000 pigs are frequently killed daily in summer; 20,000 constitute a full day's slaughtering in winter. Two thousand tons of meat are sometimes dispatched in a single day from the railway sidings which are conveniently brought into the premises. The works cover fourteen acres; the buildings are four stories high, and are being constantly added to. There are six lifts, and hydrants and fire hose are fixed at convenient points on every story. A trained fire brigade is recruited from among the operatives. The premises are insured for a million dollars, the annual premium on different parts of the works varying from one to one and three quarters per cent. Two thousand men are employed in summer, and three thousand five hundred in winter. Everything is done by day work, but all is so

systematically and effectively arranged that no man can shirk his duty. Incompetence or idleness cannot be tolerated, for one man's trifling might stay the work of hundreds. The wages are from 6s. to 8s. per day of ten hours for ordinary laborers; but the butchers and skilled operatives, numbering about five hundred, earn 10s. to 15s. a day. Wages are higher in winter than in summer, and payments are regularly made every Wednesday.

The raw material which keeps this great establishment moving is conveniently found in the contiguous market, where 60,000 hogs are sometimes pitched in a morning, and on one occasion last summer the number ran up to 80,000. On one of Fairbanks' standard scales, which will weight forty pounds or forty tons, the lot of pigs is duly weighed. They are selected for various markets and purposes from six to eighteen months, ranging from one hundred and fifty to two hundred and fifty pounds. The average weight of the summer pigs is two hundred and eighteen pound, of the winter two hundred and forty-six pounds. Messrs. Armour have large pens and yards where their purchases are fed and watered until required. No fasting is practiced as in England. The grunter has his breakfast even if he is doomed before dinner time.

HOW THE HOGS ARE DRESSED.

In the afternoon Berkshire and Essex hogs, varying from two hundred and fifty to three hundred pounds live weight, were being driven along the ascent and over the "Bridge of Sighs" into the third story of the building, in which the slaughtering is conducted. About a score are inclosed together in a catching pen. Around the victim's hind limb just above his dew-claw a piece of chain with a tolerably large ring at either end is passed. From a roller overhead is lowered a chain, terminating with a hook, which is deftly passed into the ring on the limb; the long chain is steadily wound up by steam. When the pig's head is about five feet from the ground, another hook, suspended from a wheel, is fixed into the ring round the limb. This wheel runs on a stout one-and-a-half-inch iron rail, which is carried onwards through several large rooms for one hundred yards, always at an incline, down which the pig is carried by his own gravity. The hog, astounded at being raised heels first from the ground, makes little resistance, and is swung over the wall of the catching pen. With one sweep of a sharp short knife the executioner severs the arteries and veins of the neck. The blood flows through a grating into the premises below; every half minute the foremost of a row of some six or eight, now perfectly dead, is unhooked and plunged into a vat of steam-heated water, where he remains about three minutes, and where nine or ten are immersed together. Every thirty seconds, or oftener, at the lower end of the vat, a great, curved, rake-like gridiron lifts a smoking hog on to the table, along which passes an endless chain, to which, fastened by the nose, he is drawn among ingeniously conceived and accurately working spring scrapers, driven by steam, and invented by one of Messrs. Armour's chief engineers. On each of seven cylinders are placed forty-eight steel blades, and so exactly and effectually do they work that in ten seconds the hog emerges from the machine thoroughly denuded of hair. Any slight oversight is made good by handscrapers wielded by a couple of men on each side of the bench. Necessity, as usual, led to the discovery of this handy machine, which saves the labor of ten men. The scrapers, who were making $3 a day, struck. They thought that, at any sacrifice, they must be retained. They reckoned not that machinery could supersede their laborious manual service, which at other places I have seen done by eight or ten stalwart negroes, usually working stripped to the waist. Here, as everywhere throughout the works, perfect order and cleanliness obtain. Vulcanized India-rubber hose hang suspended over the table, and jets of water, as required, are directed over the carcass, removing any adhering hair, scurf, or dirt. Again the hog is raised, this time by the nose; steam, as before, doing the lifting. Down the inclined rail he swings. Detained for a few secoads over a bench, he is disemboweled, each portion of his internal organs being carefully separated, cleansed, and set aside for use. The lungs, heart, and liver are forwarded to the sausage department; the stomach, cleansed, also follows, to be used as a bag in which to pack some of the sausage meat, of which more anon. The intestines, stripped of fat, are scalded and form cases for the sausages. Over the next table the head is cut off, the eyes and brain are removed for the lard tanks; the tongue is taken due care of for potting; the ears, a dainty, gelatinous morsel, are preserved and canned. Still suspended from the iron rod, down a long passage, guided by a small boy with a long pole, and round a corner into a big cooling room swing along six hogs at a time. Here, to insure thorough cooling, they are cleft down on each side of the backbone, and again run along, still hanging from the ceiling, and arranged in battalions of several scores. The time taken to catch the hog, slaughter, cleanse, dress, and deliver him in this cooling chamber is fifteen minutes.

In this lofty room, at a temperature during autumn of about 40° Fahrenheit, the air kept in motion by overhanging punkahs, the hogs hang five or six hours. To hasten cooling, they are then divided down the back, the two sides only held together at the neck, and are moved, still wheeled on the iron rails, dependent from the ceiling, into the ice chamber, which is four hundred feet long and two hundred feet wide, located in the middle of the building, and maintained at about 38° Fahrenheit by a twenty foot stratum of ice stored overhead. In this chilly atmosphere, darkened to economize ice, with a boy stationed at every entrance to insure rapid closure of the doors, the hogs remain about thirty hours. On the thoroughness of this cooling depends the success of the whole operation of summer hog packing. Although in winter little ice is requisite, the summer demand absorbs five thousand car loads, each containing about fourteen tons.

Firm and dry, the carcass, still suspended on the labor-saving rails overhead, is run to the door of another long room, is separated into two sides, and now for the first time is moved by manual labor. By a strapping fellow each side is seized, carried a few yards to a solid bench, where, with a powerful chopper, with a blow that would astonish a Mameluke, the ham is severed, as accurately the shoulder and underlying ribs are cut off, leaving a rectangular side of bacon. A gentler blow separates the feet, which are canned, pickled, or passed into the lard tanks. These skillful swordsmen, who never maul, and cut to a hair's breadth, receive 14s. a day in summer and 16s. in winter. The sides of bacon have the backbone partly or entirely removed; the tender loin or fillet, being more difficult to cure, is taken out, and sells readily for immediate use.

PREPARATION OF BACON.

The sides of bacon, averaging about fifty-six pounds, are removed on trucks to the salting-house, thoroughly rubbed with salt, the Canadian and Liverpool being preferred, and a very little saltpeter. Each side takes up two pounds to three pounds of salt. In a dark, cool store-house these sides are piled to the number of sixteen or twenty, one on the top of the other. After the lapse of a week they are turned over and again rubbed. Occasionally they go out in twenty days; but if intended for long keeping they require double that time. Every piece, as it passes from the salting house, is examined, a tester thrust in to ascertain if any taint has accidentally been incurred. It is then washed, scraped, dried, and packed. Large boxes containing eight to ten sides of bacon, or five hundred pounds, are almost daily being put up for European markets. Messrs. Armour have large contracts with the United States Government, and at a push, one hundred and fifty of these boxes can be put up in an hour. Even in this country of cheap lumber these boxes cost fifty-six cents each. The bacon bought unpacked goes at nearly a cent less per pound. Of those sides of bacon and shoulders, which are treated in much the same way, Messrs. Armour turn out yearly upwards of eighty million pounds weight. So economical and systematic are the arrangements, and so carefully is the best made of everything, that the sides of bacon and shoulders can with profit be disposed of, even at the present enhanced price, at a trifle over 3½d. per pound. In Liverpool and many other United Kingdom ports large quantities of this bacon, as well as of the barreled pork, are purchased, washed, nicely smoked, and disposed of at a handsome profit as "Prime Wiltshire" or "First-class Yorkshire."

In imitation of the British home-cured, singed bacon is now produced. The hog is swung from the slaughtering pen on to a hearth, where it is singed among straw and wood shavings, and its pachyderm rendered more tender. The belly pieces from smaller hogs, pickled in great vats, constitute a growing trade. Of this pickled pork forty thousand casks, each containing two hundred to three hundred pounds, are put up annually. These used to go chiefly to the lumberers, the sugar and rice plantations, and the West India Islands, but now a great demand has grown in this country, in France, and Belgium; tons are used in London, boiled with Ostend rabbits; 4½d. per pound is the wholesale price.

MAKING HAMS.

The hams are of especial interest, for a very large proportion come to England, of sizes and cuts to suit various markets. They are sold under many *oliaves*, and are recognizable in Bond street and other fashionable London shops, where their Chicago origin is not conspicuously set forth. Messrs. Armour last year turned out upwards of five million pounds of hams. Their London house alone received during 1879 nearly 300,000 hams, averaging twelve pounds to thirteen pounds each, and sold wholesale at about 6d. per pound. In a sweet pickle, made with salt, sugar, and saltpeter, the hams lie in vats for sixty to seventy days, and are changed over three times. Some are subsequently hung for three days in the smoking house, amid empyreumatic antiseptic vapors of maple sawdust; are scraped, brushed, sewed neatly in calico, stamped, and packed thirty to forty together in a box with a partition down the middle, to insure ventilation and lessen the risks of bruising. In summer for air they come in crates. The breakfast bacon—the light bellies from pigs six or eight months old, in handy shapely pieces of eight to ten pounds—is treated much in the same manner as the hams, and, when smoked, brushed, and cleaned, is transferred to a packing room, where each piece is rolled tidily in gray paper and sewn in calico by men who manage the needle with cleverness that a seamstress might emulate. In this department I saw twenty men busy, but in winter one hundred are often occupied. Each is expected to put up two hundred to two hundred and fifty parcels for his day's work; the pay varies from 6s. to 8s. a day, but extra money is given for extra work or for extra hours. The breakfast bacon thus neatly sewn up for the American market is brushed over with a solution of chrome and rice-flour to prevent access of flies; but the British public naturally object to this coating of the yellow lead salt.

SAUSAGES.

The composition and manufacture of sausages are frequently a subject of suspicion and ridicule; but the materials and making here are above all doubt. In five large vats the steam-driven mincers are constantly reducing to a fine pultaceous mass portions of meat, trimmings from the sides and hams, with the heart, liver, and internal parts. From the usual machines, twenty thousand pounds of sausages is usually put up daily, and are readily cleared off by the pork butchers, hotelkeepers, and others, at about five cents per pound. Extra work is often required from this department. Several descriptions of sausages are made—liver, blood, and pork; Frankfort, which is partly cooked and smoked, and keeps a week; Bologna, prized in Germany; "the lion," which is chiefly sent to France, and keeps a year. A new manufacture has recently been begun. The soft parts of the heads, cleansed and minced, are flavored with salt, pepper, and spice, carefully cooked, canned in two pound and four pound square tins; are ready for immediate use, or will keep ten years, and are known as head cheese or brawn.

The American hogs yield about 5,000,000 cwt. of lard. The summer killed average thirty-four pounds, the winter thirty-seven pounds. Messrs. Armour, buying hogs above the average in condition, have a yield of fully forty pounds of lard from every pig killed. In fifty tanks, heated by worms from ten boilers, the fat and other refuse, melted during ten to twelve hours, are drained off in different grades. The first quality, made from leaf and trimmings, is recognized as "prime steam lard." The intestines and refuse yield a lower quantity, known as No. 2 lard, a large proportion of which goes to Europe. Some of the bristles are conserved for brushes and for the cobblers, but the bulk of the hair is sent to this country in bales of five hundredweight, and, mixed with horsehair, is used for stuffing railroad and other carriage cushions. It is now worth £14 per ton. The blood, dried in a revolving steam-heated cylinder, contains about fourteen units of ammonia, and is sold for $28 to $30 per ton to the sugar refining and manure manufacturers. For this latter purpose the firm are now treating for the delivery of four hundred tons in the Thames at £12. The bones, after crushing and passing through the lard tanks, and the refuse from every department, are dried, pressed to get rid of grease and water, exposed for fifteen minutes in a twenty-five foot steam-heated revolving cylinder, and constitute a valuable fertilizer, containing eight units of ammonia and twenty-one of phosphates, and sold at $16 per two thousand pounds, and is in growing demand among gardeners, nurserymen, and in the cotton plantations.

In the Chicago office, Mr. P. Armour presides over the financial and business arrangements of this growing concern. Like some other Chicago merchants, he is usually at his office at 7 A.M., surrounded with correspondence, telegrams, and cabled price lists, while regularly every morning comes the statement of the London bank account of the previous afternoon. Telegrams from London, Liverpool, Belfast, Paris, Antwerp, and other parts of the world come in all day, often numbering five hundred. Forty clerks are fully occupied in this representative Chicago pig-packing concern. Doing a big business, Mr. Armour rightly declares that he can work for a small profit. He says he has got rich by selling cheaply. He insists on ready-money transactions, and makes, accordingly, no bad debts. To use his own expression, his agents go with the goods in one hand, and get the money in the other. More than half their production is exported, and of this export more than half is taken by Great Britain. For sugar-cured hams and fancy goods England is their chief and increasing market. With through rates the produce is forwarded to United Kingdom ports at little more than one farthing per pound, and during the past two years tons have been sent at half that figure.—*London Times.*

THE ELECTRIC EEL.

(*Gymnotus electricus.*)

A. VON HUMBOLDT visited South America in 1800, and was the first to give a description of the electric eel, at the same time relating the well-known story in regard to catching these animals by driving horses into the river so that the eels waste their stored-up electricity in striking the horses; thereby weakening themselves to such an extent that they can be captured with impunity. But ever since that time no reliable examinations of the *Gymnotus electricus* have been made, and as careful and extensive researches in this line were thought to be necessary, a German scholar, Dr. Ch. Sachs, was sent to Venezuela by the Berlin Academy of Sciences, to find and obtain all possible information in regard to this mysterious animal. The gentleman arrived at Calabozo in 1876, and immediately set out to capture the electric eels or tembladores, as they are named by the natives, by means of horses, in the manner described by his illustrious predecessor, but soon came to the conclusion that the natives had not the faintest idea that an electric eel could be captured in the manner described by Humboldt, and furthermore, that it had never been customary to catch the eels in that way. Dr. Sachs encountered the greatest difficulties in obtaining help to catch the eels—for the natives fear this animal more than the wildest beasts of prey, as the electric shocks they receive from it are a perfect mystery to them, as they do not understand from where the enormous power comes. Finally General Guancho Rodriguez, the most fearless and brave hunter of the Llanos, agreed to undertake the hazardous experiment, and set out with his men and Dr. Sachs. They soon caught several eels by means of harpoons, but as Dr. Sachs desired to have living specimens a second attempt had to be made. They found numerous eels assembled in a large river at the mouth of a brook, waiting to catch the smaller fishes that swim down the brook. They remain in the river, where it is absolutely impossible to catch them, but the Llaneros have a most ingenious way of enticing the animals to come into the brook. They hid themselves behind trees and threw pebbles into the brook, upon which the eels, who seem to be of a very inquisitive nature, glided up the brook

ELECTRIC EEL.

to ascertain the cause of the disturbance. A net was passed across the mouth of the brook to prevent the eels from returning into the main stream, and a second net was passed over the brook a short distance above the first, and the two nets were finally brought together and the eels caught between them. Numerous dead fishes and frogs had appeared on the surface of the water, and the various exclamations of pain by the men drawing the nets containing the eels out of the water, gave proof of the enormous strength the animals were possessed of. None of the natives would undertake to place the two eels that were caught into a barrel, and Dr. Sachs was compelled to do it himself, but although he placed his coat over the animals, he received several blows of great intensity. Dr. Sachs completed his researches in 1877 and returned to Berlin.

The organs which enable the electric eel to produce such wonderful effects are double, and lie along the body one upon the other, and consist of a great number of divisions, which are again divided by lesser transverse membranes. When full grown the animal will attain a length of from from 5 to 6 feet. The body is rounded and the scales small and barely visible.

INTELLIGENCE OF SEALS.

THE intelligence of seals is well-known. They are easily tamed, affectionate, and very docile. In captivity, however, they are much disposed to be drowsy and almost lethargic. At zoological gardens they have been taught to sit erect, to bow, to kiss the hand, pretend to be asleep and to snore, turn the crank of an organ, shoulder a gun, shake hands, and perform other similar simple tricks. Having a large brain with many convolutions, their senses, especially those of sight, smell, and hearing, are very acute. The apparent fondness of seals for music was well known to the ancients, and is taken advantage of by hunters at the present day. There has been on exhibition for a long time, at London, one of these animals, which, for its extraordinary intelligence, is called the "learned seal." It is kept in an immense tank, and has been taught to draw a small boat in which is seated a lad who steers the craft, and whose commands are obeyed perfectly by the animal. The accompanying illustration of this novel mode of locomotion appeared in the London *Graphic*. After being unharnessed, this seal thrums the strings of a guitar which the attendants place beneath its fins, much to the delight and amusement of the spectators.

SKIFF DRAWN BY A SEAL.

THE FOOD OF BIRDS.

UNDER this title, Prof. S. A. Forbes has published in the Transactions of the Illinois State Horticultural Society a valuable report on the food of the thrushes. In Illinois there are estimated to be three birds to an acre during the six summer months. We make the following extracts: "It is my own opinion that at least two-thirds of the food of birds consists of insects, and that this insect food will average, at the lowest reasonable estimate, twenty insects or insects' eggs per day for each individual of these two-thirds, giving a total for the year 7,200 per acre, or 250,000,000,000 for the State—a number which, placed one to each square inch of surface, would cover an area of 40,000 acres.

"Careful estimates of the average number of insects per square yard in this State give us at farthest 10,000 per acre for our whole area. On this basis, if the operations of the birds were to be suspended, the rate of increase of these insect hosts would be accelerated about seventy per cent., and their numbers, instead of remaining year by year at the present average figure, would be increased over two-thirds each year. Any one familiar with geometrical ratios will understand the inevitable result. In the second year we should find these pests nearly three times as numerous as now, and, with that astounding acceleration of increase characteristic of geometrical progression, they would mutiply until in about twelve years we should have the entire State carpeted with insects, one to the square inch, over our whole territory. I have so arranged this computation as to exclude the insoluble question of the relative value of birds and predaceous or parasitic insects, unless we suppose that birds eat an undue *proportion* of beneficial species.

"Take another view of this matter. According to the computation of Mr. Walsh, the average damage done by insects in Illinois amounts to twenty million dollars a year. Large figures certainly; but when we find that this means only about fifty-six cents an acre, we begin to see their probability. Few intelligent farmers or gardeners would refuse an offer to insure complete protection, year after year, against insects of all sorts, for twenty-five cents an acre per annum, and we will, therefore, place the damage at one-half the above amount—ten million dollars per annum.

"Suppose that, as a consequence of this investigation, we are able to take measures which shall result in the increase, by so much as one per cent., of the efficacy of birds as an insect-police, the effect would be a diminution of the above injury to the amount of sixty six thousand dollars per annum, equivalent to the addition of over one and a half million dollars to the permanent value of our property; or if, as is in fact a most moderate estimate, we should succeed in increasing the efficiency of birds five per cent., we should thereby add eight and one-fourth million dollars to the permanent wealth of the State, provided, as before, that birds do not eat unduly of beneficial species.

"These figures will be at once rejected by most naturalists as absurdly low. The young robin of Prof. Treadwell (a bird whose fame has extended over both hemispheres) required not less than sixty earth-worms a day, equivalent to at least two hundred and fifty average insects, to keep it alive. A pair of European jays have been found, Dr. Brewer informs us, to feed their brood half a million caterpillars in a season, and to eat a million of the eggs in the winter.*

"Compared with these numbers, my 7,500 insects a year seem certainly many times too few, and similar criticisms might very probably be made on other items of the estimate. I prefer, however, to put these matters with a moderation which will command general assent, especially as we see that the importance of the subject does not require exaggeration. Of course the individual farmer or gardener could, by intelligent and careful management, if he knew just what to do, increase the value of his own birds far beyond his individual share of the above-mentioned general aggregate.

"It is thus made probable that the birds intervene continuously between us and the complete destruction of our most important industries, the irretrievable financial ruin of nearly our whole population."

In conclusion, Mr. Forbes does not, with his present knowledge of economical entomology, attach any great economical value to the thrush family; it appears from his paper that they often eat many insects beneficial to agriculture, particularly ground beetles, still he would treat this question with careful conservatism, and not turn the delicate balance of nature by the extermination or undue breeding of birds.

* A young mocking-bird (*Mimus polyglottus*), raised from the nest by my nephew, Robert Forbes, ate about 240 red-legged grasshoppers daily, equivalent to at least 480 average insects.

COAL-GETTING MACHINE.

ONE of these machines (of which the accompanying figure is an illustration) in a thin seam of hard coal in a Scotch pit has, we are informed, for a period extending over two years, worked regularly five days a week, hewing out of this seam, only 22 inches high, an average of 130 lineal yards of coal every night, which, in a 4 foot seam, would yield 180 tons of round coal per shift, the shift being eight hours. This is, without doubt, a very valuable practical test of a coal-cutter, as we have here at the outset a proof that the machine is capable of doing continuous work, and would appear, in fact, to be a reliable tool.

The Rigg-Meiklejon machine cuts on what may be termed the circular saw system, the saw or cutting disk being supported by a strong jib or bracket. As regards its construction the inventors of the machine claim for it many novel advantages, as for instance: (1.) The machine holes or cuts into the face at the bottom or underside of the sleeper supporting the rails, or in other words flush with the *thill* or bottom. (2.) The height of the machine being under 16 inches enables it to be employed in thin seams, which would otherwise be expensive to work. (3.) The arrangement of the endless chain or rope for dragging is improved and simplified. (4.) The arrangement of the four adjusting screws at each corner, by which the cutters can be made to work at any required angle. (5.) The axle boxes are also so adjustable as to allow the machine, when progressing at an angle, irrespective of the level of the rails or sleepers. (6.) The arrangement for holding the teeth or cutters, by which any number and any shape may be employed according to the nature of the material to be operated upon. (7.) In compactness and the simplicity of its working parts, combined with great rigidity and strength.

A gentleman who went to see the machine at work reports: "The machine was found at work on a wall of about 150 yards long, from a level at one extremity to a heading at the other in the 'Splint' seam, 24 inches thick, and during our observation cut a distance of 84 yards up the face in the most satisfactory manner and without any abnormal assistance. The undercut was 3 or 3½ inches high and 3 feet to 3 feet 2 inches deep. Taking the whole period of our observation, the rate of cutting, including all stoppages, gives an average of 33 yards per hour, although for some minutes at a time a rate of 40 yards per hour was attained with a velocity of 100 revolutions of crank per minute."

Another gentleman reports: "I may say I was a thorough skeptic about coal-cutters until I saw the Rigg-Meiklejon machine at work. The seam in which it was cutting was 19 to 24 inches high, and it has been working in this pit for two years. I have a note of the work done the night I was down which I made at the time. I marked every stoppage and the cause of the stoppages. I stayed the whole of the shift there, and there were one or two stoppages which were beyond the control of the machine altogether, but taking the usual data the work done was 129½ yards per shift of 6 hours 35 minutes"—3 hours 6 minutes of which the machine was stopped, changing rails and picks, and 3 hours 29 minutes it was cutting—giving an average amount of 37 yards per hour of cutting.

It is needful to explain that the quality of the coal in this seam is very hard, and has been pronounced to be similar to the North Country Low Main, but slightly harder and more brittle. The proportion of round coals to small got by the machine is stated to be as twelve to twenty—that is, with the machine out of a score of twenty tubs twelve are round. In a part of the pit where the seam is 30 inches, there is less than one-half round coal got by hand holing—that is, by hand labor, out of every twenty tubs in a 30-inch seam there would be nine tubs of round as compared with twelve tubs by machine in the 22-inch seam, and if this 22-inch seam were to be worked by hand labor very little round coal would be got, because in a kirving of 3 feet 6 inches deep about 16 inches in height of coal would have to be hewn out to waste in the fore part of kirving, whereas the kirving the machine makes is only 3¼ inches high from the front to its extreme depth. It is further to be noted that the kirving, holing, or the cut in the coal is made down at the flush of the pavement or level of underside of rail sleepers, and leaves no layer of coal to be picked off. By this improvement the machine saves a great loss in small coal as well as labor, leaving, as it does, the pavement ready to receive the machine rails without further preparation.

The whole of the work is performed by three men and a boy, who are paid by the ton, the coal being filled in the day-shift by the fillers. The amount of cutting, in yards, taken over a period of two years, averages 130 yards per shift of seven hours in a seam 22 inches high, and as much as 1,000 yards of the hard coal have been cut in five consecutive shifts.

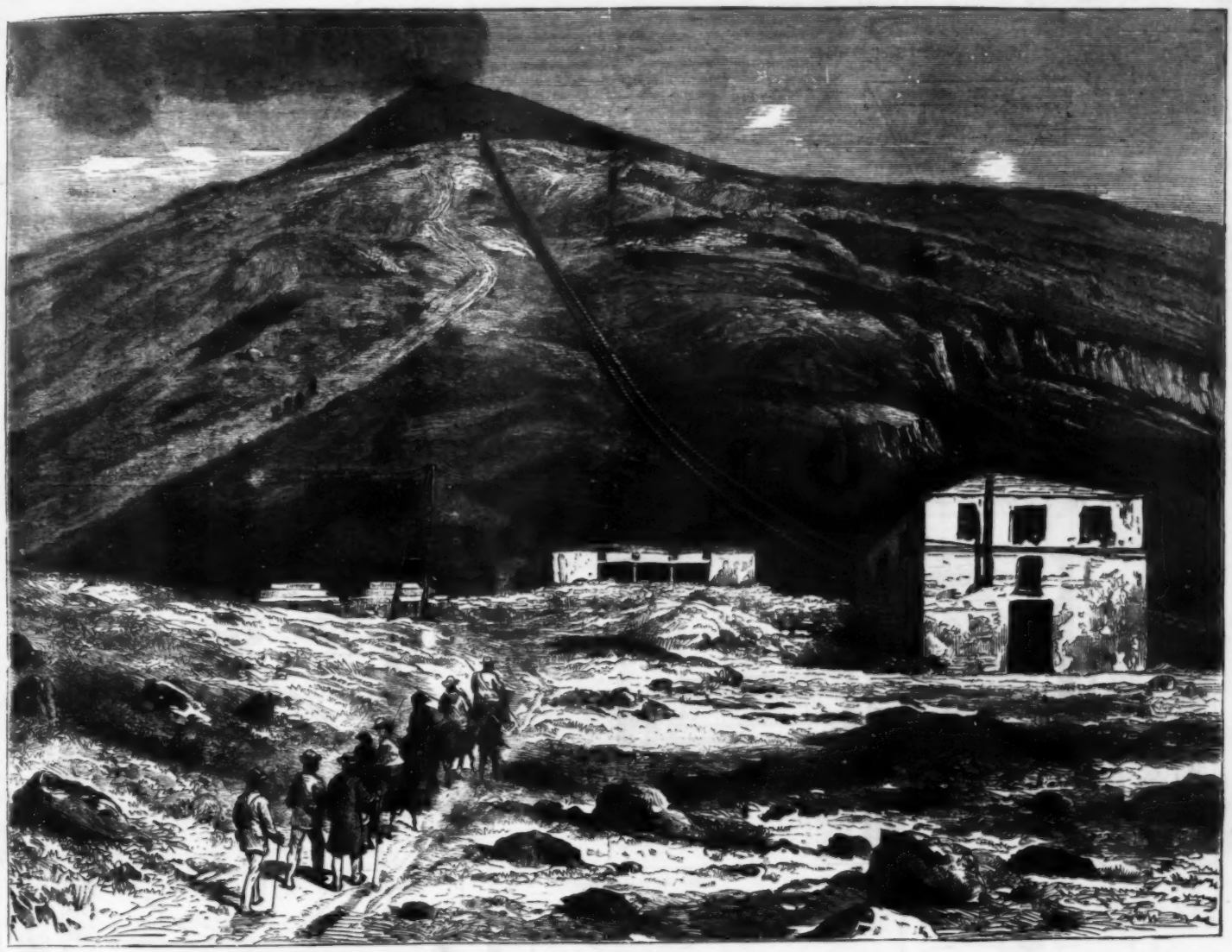
In 240 working days, 31,200 lineal yards of coal, it is affirmed, have been cut in this seam, averaging 24 inches thick. Now, one yard of coal 3 feet 6 inches depth of holing costs 3d. to cut, including men's wages, attending and working the machine, sharpening and renewing cutters, general repairs and up-keep, and as we take it that compressed air can be delivered into these machines at the rate of 4d. per h. p. per hour, it follows that the consumption with the "Rigg-Meiklejon" machine would amount to 1¼d. per lineal yard of holing—making the total cost for holing 4¼d. per lineal yard at 3 feet 6 inches deep. The cost of holing per lineal yard (exclusive of pit arrangements) is the same whatever thickness the seam may be, and if a yard of coal holed 3 feet 6 inches deep and 3 feet high (which is equal to one ton of coal) can be cut for 4¼d., it will be perfectly evident that with seams 6 feet high the cost per ton would only be one half, namely, 2⅛d. per ton of coal cut, and left at face ready to fill.

It will be seen from the foregoing notes that the machine has been doing a large amount of continuous work, and we are informed that during the two years there have been only trifling repairs necessary, and no working part of the machine has given way.—*Colliery Guardian.*

COAL GETTING MACHINE.

THE RAILWAY UP VESUVIUS.

THE ascent of Mount Vesuvius up to within a mile or so of the cone itself is not particularly laborious, and indeed hitherto has been usually accomplished by carriage as far as the inn below Professor Palmieri's Observatory, as there is a capital road all the way from Naples. Close by the Observatory, however, the road was wont to end, and thence would-be ascenders walked over a footpath cut in the streams of hardened lava to the foot of the cone, where they would begin their three hours' zigzag climb of a slope that barely takes seven minutes to descend—pestered half the way with porters anxious to carry them up on a litter—ship deep in loose ashes and crumbling scoriæ. Now, however, the ascent can be made with all the "modern improvements" which the ingenuity of engineers can suggest. The carriage road has been extended to the foot of the cone, and there is situated the lower station, from which the train starts for the summit, a distance, as the crow flies, of a little over a thousand yards. The upper station is built about



THE NEW RAILWAY UP MOUNT VESUVIUS.

260 yards from the mouth of the crater, the whole return journey from Naples now costing a napoleon. The line is worked on which is termed the "funicular" system, the carriages not being propelled by a locomotive, but being drawn up and lowered by means of two endless steel ropes and a windlass, which, set in motion by a steam engine, is placed in the lower station. The line has been constructed with great care upon a solid pavement, is planked throughout, and is believed to be secure from all incursions of lava. The wheels of the carriages are so made as to be free from any danger of leaving the rails, besides which each carriage is furnished with powerful automatic brakes, and these, in the event of any rupture of the rope, would stop the train almost instantaneously. No little difficulty was found in obtaining a water supply, but this was obviated by the formation of two large reservoirs, which may be seen on the left of the station in our sketch. The gradients throughout the line are exceedingly steep, varying from 10 in 135 to 63 in 100, the mean being 56 in 100. The ascent only occupies seven minutes, but it is to be doubted whether those who will henceforward climb Vesuvius in this manner will enjoy the hearty lunch of eggs roasted by the guides in the hot sulphurous cinders, and the deliciously refreshing bottle of Lachryma Christi brought up from the inn below, as much as after the good two or three hours' battle with the slope and the cinders which they would have to have fought before the advent of the iron way.—*London Graphic.*

[For additional views of this remarkable railway see last week's SUPPLEMENT.]

AN INTERESTING EXPERIMENT.

A TRIAL of Dr. Charles Holland's hydrocarbon retort was made lately on the Long Island Railroad, between Long Island City and College Point. The invention, which consists of an apparatus for the decomposition of water into oxygen and hydrogen, and the incandescence of these two gases with the aid of superheated steam, with the carbon of petroleum or naphtha, so that a combustion, which is almost perfect, is obtained, was applied to the boiler of the great locomotive "Hempstead," which is one of the largest locomotives in the United States. Very little alteration of the engine was necessary. J. W. Houchin & Son, the Brooklyn engineers, were in charge of the arrangements, but they had to do little more than place the retort in the fire box and connect it with the naphtha tank in the tender. There were 180 jets of a flame at white heat in the retort, and the flames on trial experiments made before the train was started were turned off and on almost instantaneously. When the train was put under way the advantages of the retort became instantly apparent. There was little smell from the engine and no smoke, and of course no cinders or sparks. During this trial trip an estimate of the amount of naphtha consumed was made, and it was found that the cost was 7½ cents for a run of six miles, which is much less than the consumption of coal would amount to. Engineer Edward Harris, who ran the train, said that he was perfectly satisfied with the working of the retort. One of the advantages claimed for the retort system is that when no power is needed, as on down grades, the fire can be cut off and the fuel saved. So far as the application of the retorts is concerned, Dr. Holland says that they can be fitted to any engine, and the experiment clearly showed that the difference in the manner of the motive power made no difference in the manner of controlling the engine.

In connection with the above it may be interesting to state that the Germans appear to be making rapid progress in applying gas firing to steam boilers. Herr G. Liegel, of Strausland, announces that by a system developed by him he has obtained very favorable results. During an experiment lasting 72 hours, he evaporated in a boiler having a heating surface of 27·1 square feet, 9,766 pounds of water, having an average temperature of 62 degrees. In order to do this he used 1,058 pounds of coke. Taking into account that 164 pounds of ashes were left behind, it will be seen that 894 pounds of carbon were actually used, so that 10·92 pounds of water were evaporated for every pound of carbon, which if the hydrogen in the coal, 0.56, be taken into account, would yield a useful effect of 82·3 per cent.

ON THE ADHESION OF BELTS.

By J. H. COOPER.

THE driving power of belts, by which we mean the holding on to, the adhesion, or that which imparts motion to a belt while in contact with a revolving pulley, has been attributed to several causes, to one of which I wish in this short article to refer—that of atmospheric pressure. It is called to mind now by reading some articles in late issues of scientific papers, which lay great stress upon the efficacy of this means of creating adhesion. This announcement is much like that startling physiological statement of the many tons of pressure imposed upon the human body by the atmosphere, which is very taking to the sense until better known.

A belt has a movement to and from a pulley with perfect freedom, regardless of the atmosphere, *touching* it as its form, pliability, and strain permit, and *holding* to it according to interposed unguent, adhesive, or viscous substance, which has been spread over the surface of belt and pulley.

The kind of intermedia used has much to do with the driving power of belts. If fine lubricating oil be employed on clean surfaces of belt and pulley, it will effectually exclude the air from the surface of contact, but the driving power will be reduced to a minimum, if there be any at all transmitted. If dry dust of yielding material be employed on clean surfaces of belt and pulley, then, indeed, will the air with the dust diminish driving power.

There are conditions of belt driving where it is alleged the interposed film of air *lessens* adhesion. Upon this Rankine says: "It is well known through practical experience that a belt for communicating motion between two pulleys requires a greater tension to prevent it from slipping when it runs at a high than at a low speed. Various suppositions have been made to account for this, such as that of the adhesion to the belt of a layer of air, which at a very high speed has not time to escape from between the belt and the pulley. But the real cause is simply the centrifugal force of the belt which acts against its tension, and therefore slackens its grip of the pulleys."

In collecting "belting facts and figures" during the last score of years, for my own use, I met with several statements asserting with considerable confidence the doctrine of "suction" as the chief cause of attachment between pulley and belt, but I could not find anywhere written a fair statement of reasons why such a force did or did not act according to the circumstances of belt driving, nor could I discover any appeal to experiment which, by removing the atmosphere, putting suction outside the apparatus (as it were), and thus settling once for all the value of vacuum for belt driving.

It is very true that if the belt does not touch the pulley it cannot pull it around, nor can it be driven by the pulley. It is also true that if belt and pulley touch on a limited area only, each can drive the other with a force, but a part of what it is capable of doing. and it is only when contact is made perfect, that is, when every square inch of the belt, so to speak, is down solid on the pulley surface, which surface we will grant is very smooth, that the greatest driving effect is obtained.

In practical proof of the necessity of contact and exclusion of air, I offer the accidental discovery of a correspondent of the Boston *Journal of Commerce*, March 5, 1880:

"Some time since I was running an Andrews pump No. 4, elevating water through a 6-inch pipe 23 feet high, driving the spindle with an 8-inch belt on a pulley 12 inches diameter; 825 Rpm.

"The pulley was on the under side of the belt. I was greatly troubled with slipping and 'squealing' of the belt. Not wishing to run the belt any tighter, I ordered three rows of holes, ⅛ of an inch diameter, 2½ inches distance on the circumference, to be drilled, preparatory to facing with leather and rivets through the holes. Not being able to finish the job immediately, the belt was put on, and greatly to our surprise worked without slipping or 'squealing' at all, perfectly noiselessly. *The air was let out through the holes.*"

These things being so, are we yet warranted in concluding that the imparting of motion from belt to pulley and pulley to belt is all the work of the air, or, rather, the effect of its absence from the region of contact and the presence of it on opposite sides of belt and pulley?

Again, is the driving of the belt in the same direction as that in which the suction is felt? Now mark, the atmospheric resistance becomes sensible by pulling at *right angles to a plane surface of joint which does not admit air;* release the pull and try to slip the piece used for testing (which may be of wetted leather of handy size) over the surface to which it is applied; it moves freely in every direction, offering no resistance, possessing no adhesion, being, in fact, in equilibrium, and by lifting one edge can be raised wholly away with ease.

The power of the belt does not move in lines at right angles to its contact with the pulley face, but tangent to the pulley circle, parallel to the face of contact; as we slip the *sucker* freely on the flat, wetted surface, so the belt slides on the pulley face; there is no atmospheric pressure manifest in either case.

But has any one tested this matter in a vacuum and made record of the results gained? I have; and if you allow me I will quote from "Use of Belting" what I said about this several years ago:

Fig. 1. Vertical Section (side).

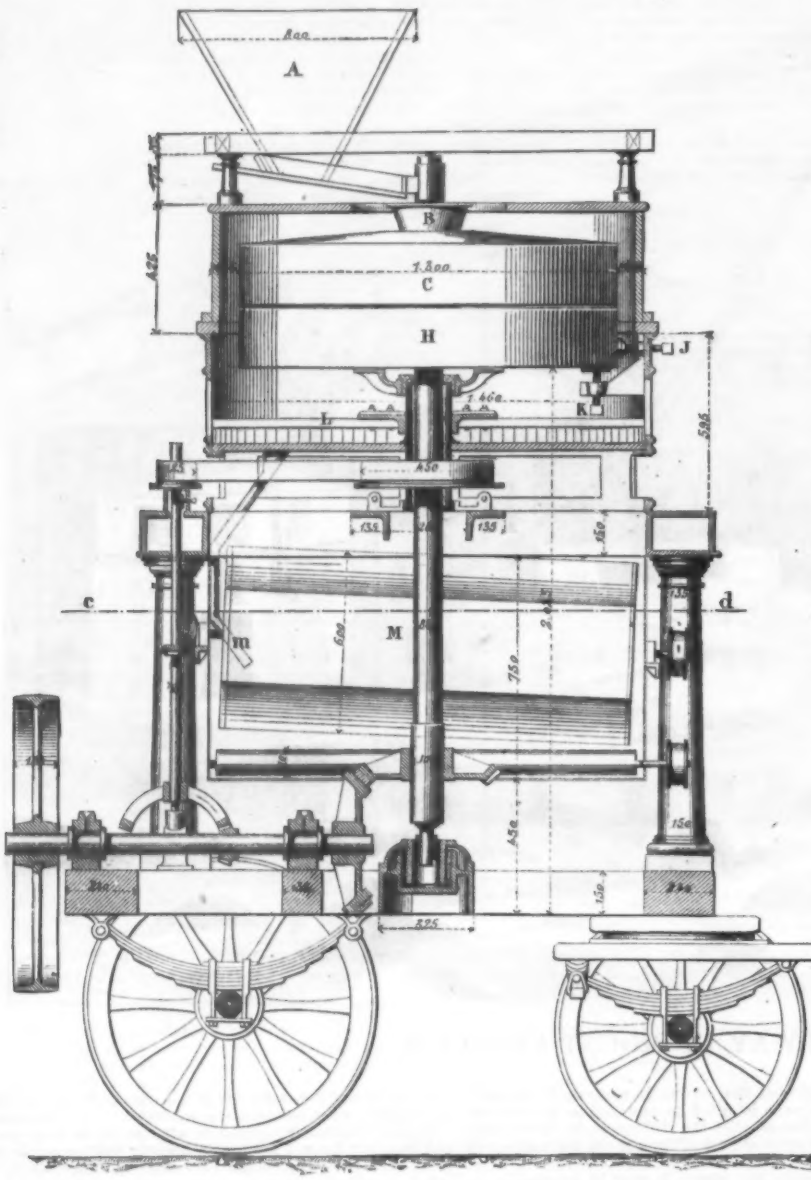
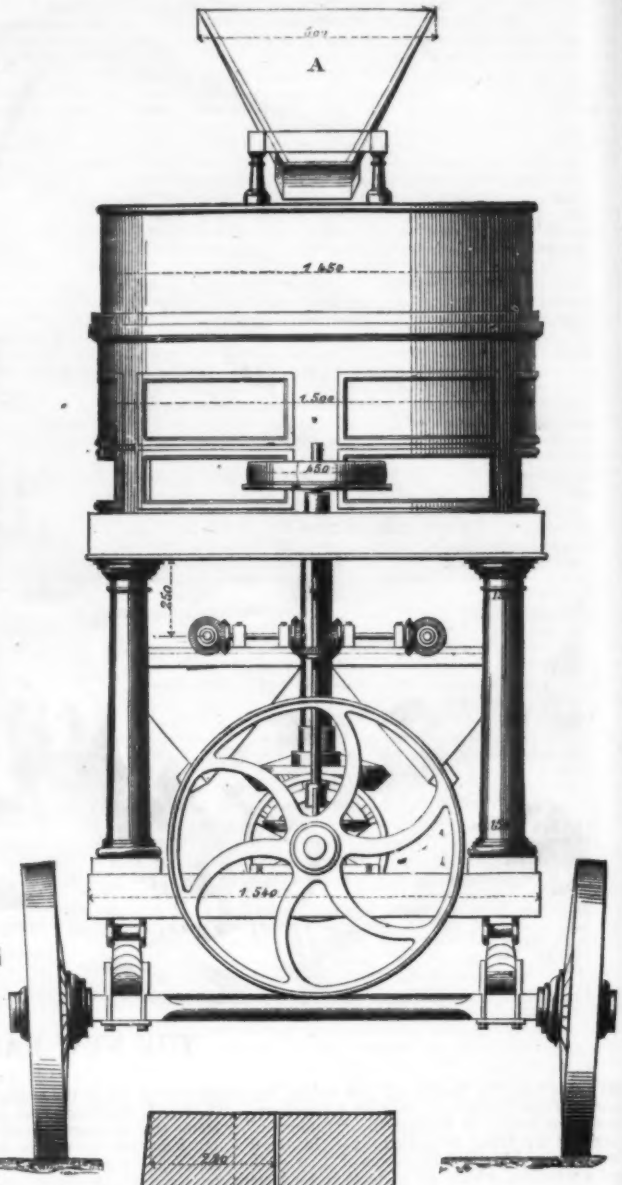


Fig. 2. Vertical Section (end).



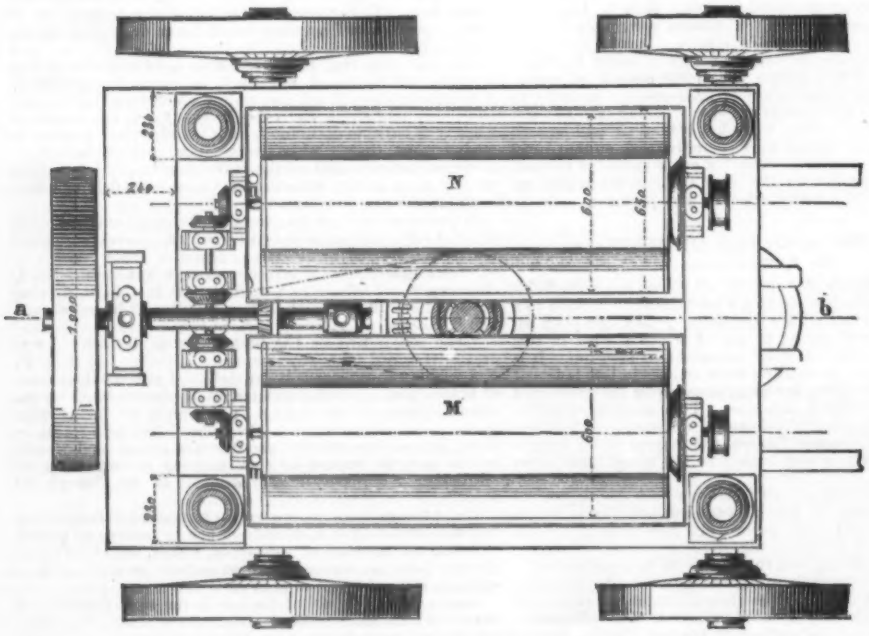
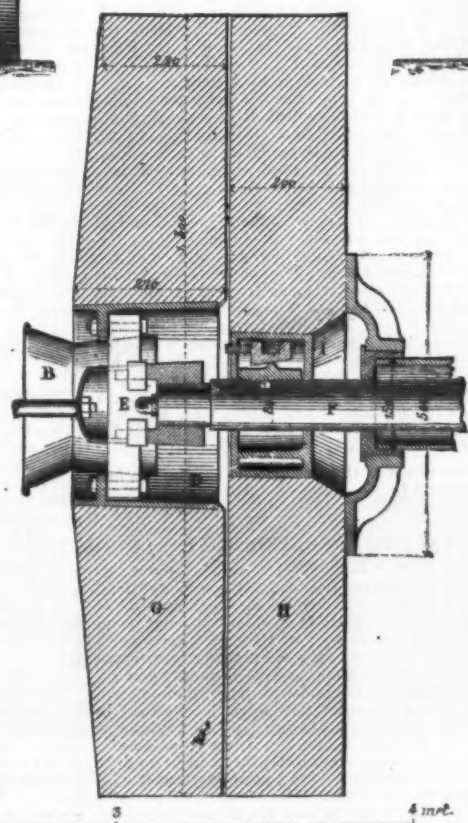


Fig. 3. Horizontal Section.



0 1 2 3 4 met.

Fig. 4. Section of Mill-Stones, Showing how they are mounted.

AUBIN'S DIRECT-BOLTING PORTABLE MILLS.

The adhesion of belts to pulleys is frequently attributed to the pressure of the atmosphere, and in order to show how much the air influences belts in this particular, the following simple experiments are presented:

Take a circular disk of leather, say three or four inches diameter, with knotted string secured in its center, and, when well water-soaked, press it upon any level wetted surface. The "boys" call this apparatus a "sucker," and it well illustrates the phenomenon of atmospheric pressure, or "suction," as it is usually called.

If an effort be made to draw it away from this surface by the string, it will be found resisting very forcibly, but the gentlest pressure will slide it on the wetted surface; it does not offer the slightest opposition to motion in the direction of its face, nor will it resist removal if raised first at the edge and then peeled off.

The atmosphere does not press two bodies together when it can get between them; it is only when excluded by a tight joint that the development of its pressure is possible, and it becomes sensible only when an effort is made to separate them by a force acting at right angles to the plane of their faces.

Another simple experiment shows that when two level, smooth, and clean surfaces come together by a motion like the closing of a book—which is similar to that of a belt coming in contact with its pulley—there will be retained between the two a thin film of air, and while this remains, the contact of the two is imperfect, and the sliding of one over the other is easily performed. Take two iron "surface-plates," which have been scraped down to a practically perfect plane, and lay one of these on the other, like a belt goes to a pulley; they will be found not in contact at all, but as if floating one on the other, and the top one will slide off by its own weight at the least inclination of the lower one.

Much of this interposed film of air can be displaced by a sliding of one plate on the other, starting, say at one corner, with the plates in close contact, and carefully pushing one over the other, holding it the while close to, as if to keep the air out. Then, indeed, an obstinate resistance to sliding will be felt, and the friction of nearer contact will be made thoroughly sensible.

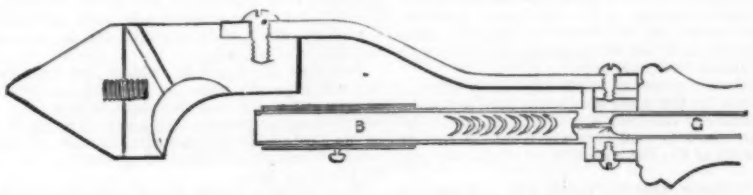
But this way of bringing surfaces into contact has nothing to do with belt action, except to prove the need of a plastic surface on belt and pulley, which will enable them to adhere, while in contact, with sufficient force to prevent sliding, and at the same time be uninfluenced by the intermedium of air.

And lastly, in order to put the matter to actual test, an apparatus was constructed, such that a leather belt was made to slide on the face of a smooth iron pulley, and also to drive the same iron pulley up to the slipping of the belt. In both cases the adhesion or driving power of the belt was held by a spring balance, so the work of the belt could be observed.

Experiments were tried with this mechanism placed in a bell glass jar on an air pump plate, with and without air in the jar, and if any difference was observed in the adhesion of the belt to the pulley it had more in vacuum than when the atmosphere was present.—*Jour. Franklin Institute.*

NEW GAS SOLDERING-IRON.

ALTHOUGH several forms of soldering-irons, with gas burners attached, have been devised, they do not seem to have met with much favor at the hands of tinsmiths and others. Probably this is due to the difficulty of making the bit hot unless an air blast is also employed. Herr A. L. Vángel, of Vienna, believes his improvement will meet all the conditions, and he has accordingly patented a gas soldering-iron without air blast, one form of which is shown in the accompanying illustration. According to the patentee, the iron may be uniformly and intensely heated in a shorter time than with the ordinary tools, while the bits may be of any required shape. In the figure the bit will be seen to be held by a screw. G is the gas supply passing through the handle into the burning tube, B, which contains some oblique incisions for the admission of air. The combined gases are consumed at the orifice, and the flame is driven against the base of the bit. A sleeve on the tube, B, regulates the quantity of air admitted. The patentee says that a powerful flame is produced, superior to those obtained by the use of a blast; and he also describes several forms of tool with modifications in the arrangements, but the principle is identical with that shown in the figure.



DIRECT-BOLTING PORTABLE MILLS (AUBIN'S SYSTEM).

THESE portable mills (see opposite), about 19½ ft. in height, contain all the apparatus of an ordinary five-story mill, *i. e.*, (1) a hopper: (2) the millstones; (3) the distributer; (4) the bolting chamber; (5) the driving pulley, shaft, and couplings. At the upper part of the apparatus is situated the feed-hopper, A, into which is thrown the grain to be ground. This hopper leads the grain into a funnel, B, which is incased in the center of the running stone, C. Fig. 4 represents a sectional view of the stones, and shows how they are mounted. The hole of the running stone is provided with a cast-iron lining, D, which serves as a support for the rynd, E, and the upper portion of the main shaft, F, is set in a sleeve, which is securely connected with the rynd. The hole of the bed stone, H, contains a cast-iron sleeve provided with three screws, I, which, through intervening segmental bearings, serve to center the shaft. The bed-stone is centered and leveled, as in ordinary mills, on the one hand by means of three screws, J, set in the sides (Fig. 1), and on the other by means of the three screws, K. To prevent the production of heat between the stones there is a continuous space of two inches left between the latter and the casing, and through this the flour falls from the circumference into the distributing chamber beneath. In this way a continuous current of air is set up from the hole in the stone toward the circumference, and the elevation of temperature checked. The four-armed distributer is designed to distribute the grist into the bolting chamber M and N, being led thither by the pipes, *m* and *n*. The bolting apparatus are like those ordinarily in use, that is, they are in the form of octagonal prisms, and are covered with silk gauze of different degrees of fineness. The flour issues through apertures in the lower part of the bolters, and falls into bags or other receptacles prepared for the purpose. The driving pulley and the stones make 120 revolutions per minute. The whole apparatus can be drawn by a single horse.

DAVID'S IMPROVED DRAUGHTING TEMPLET.

THE annexed cut represents a templet for drawing all the letters of the alphabet, besides numerals and ornaments, and is the invention of Mr. J. A. David, of Paris. It consists of a plate of metal, rubber, celluloid, paste board, or other like material, provided with a series of short slots, which if connected produce straight and curved, radiating, parallel, and right angled lines. The templet is placed upon any suitable material, and the desired figure is obtained by following the corresponding slots with a pencil or needle, whereby the design is obtained in broken lines on the material under the templet. As examples, Fig. 1 shows the letter "B," and Fig. 2 the numeral "2," in block letters, as drawn with the above templet.

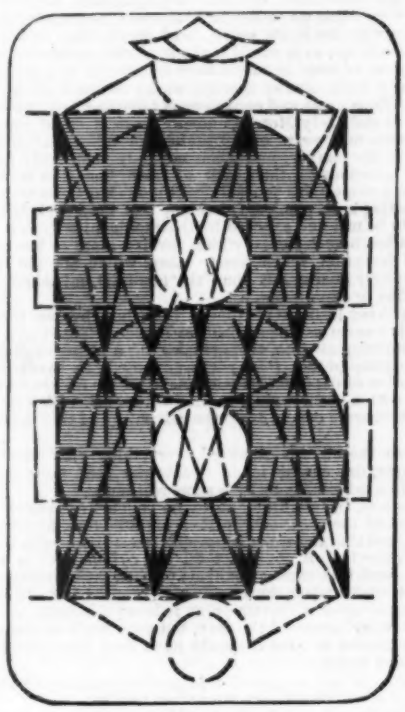


FIG. 1.

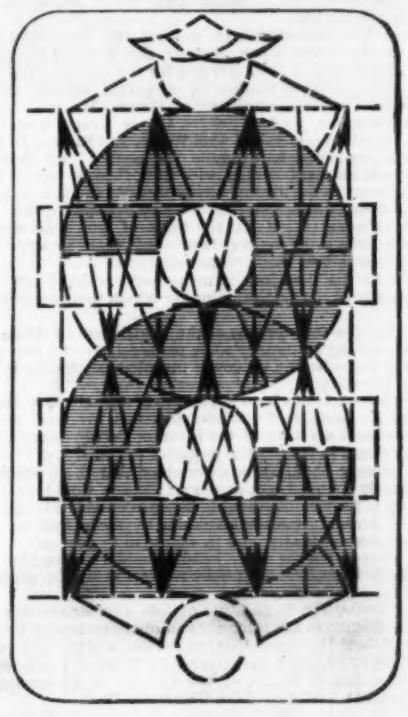


FIG. 2.

IMPROVED DRAUGHTING TEMPLET.

POPULAR FALLACIES IN ENGINEERING, AND HOW TO MEET THEM.*

By HENRY MORTON, President of Stevens Institute of Technology, Hoboken, N. J.

GENTLEMEN OF THE GRADUATING CLASS: In a time which must be reckoned by hours rather than days, you are to make your Commencement, appropriately so called because it is the beginning of your life-work, in which you are to set out on your own responsibility to act for yourselves in an essentially individual manner.

While you will, we hope, by no means cease to be scholars eager for new knowledge and ready to learn, you will also, of necessity, occupy in a more or less decided manner the positions of teachers, imparting to others, by precept and example, the sound principles and good practice which, as we hope, you have learned and developed here.

In this capacity you will often be brought face to face with errors and fallacies which it will behoove you to correct and expose, and which, notwithstanding their inherent error, or even absurdity, may come before you in so specious a dress and with such an array of seemingly unquestionable testimony in their support, that you may well be at a loss how to attack them.

It is in this connection that I wish to give you some general rules which my own experience has taught me to value, and to illustrate their application by some instances from my own experience.

In the first place, though it may seem almost superfluous to mention such a thing, establish with absolute confidence your assurance of the great doctrine of *conservation of energy* in its twofold form: namely, that no item of energy perishes in the universe, nor any item of energy is ever added thereto. That, as a consequence of this, all activities, actions, processes, are but cases of the transformation of pre-existent energy from one form to another, and thus, in order that one form of energy should make its appearance another form in proportional amount should disappear, or, in other words, that all such manifestations are but the same energy in a new dress.

Proteus-like, energy can take all shapes, but must leave one to become another, and cannot *multiply*, but can only *transform* itself.

In one of its simplest forms this amounts to the statement of the impossibility of "perpetual motion," as it used to be called, when mechanical combinations, such as those of levers, pulleys, screws, etc., were alone considered. Of late, while even in this crude shape the error still crops out not infrequently, it generally develops in a more complex and recondite form, where problems involving the less obvious agencies of chemical affinity, electric currents, or heat vibrations are discussed.

Whatever the form of the fallacy, however, simple or recondite, be *very* sure that it *is* a fallacy, whenever it involves the production of a greater amount of energy by the expenditure of a less.

Even in its simplest mechanical form you will undoubtedly before very long have to meet it, and a word of suggestion will, therefore, perhaps be useful even in this connection. Those who advocate such schemes, or who are misled by them, are not often so deficient in judgment that they will accept the possibility that a machine can move itself, and therefore the best argument to open their eyes to the erroneous nature of their conclusions is the *reductio ad absurdum*, reached by connecting the beginning and end of their train of mechanism together, and making the final piece supply motive power to the first.

For example, an inventor of this sort comes to you with a train of wheel-work, levers, etc., by which one man is to propel a train of cars. It is generally useless to follow through the steps of his mechanism, and show where the specific false assumption comes in. If he can appreciate the defect at all, he will consider it merely a matter of detail which a little study will get over; but if you pick out his final wheel, which is to give the actual motion to the car, he will, of course, admit that it will turn round with more power than a man could exert directly, or there would be no use in the intermediate mechanism.

You should then propose that this be connected as directly as possible with the wheel or lever at which the man was to work, and the man dispensed with, the manifest result being a self-propelling machine.

In curable cases this will usually be sufficient, but too often the advocate of perpetual motion is beyond the reach of reason, like that one who came to Arago for an explanation of the fact that his perpetual motion machine would stop.

Not infrequently such plans involve a mechanical fraud in the way of some contrivance by which the driving force is obtained from some concealed source.

A very beautiful illustration of this is furnished by a little model in the collection of the Franklin Institute at Philadelphia. It was made fifty years ago for the purpose of exposing such a fallacy, by Isaiah Lukens, at the suggestion of Mr. Nathan Sellers, and the machine it represents is the then famous Readhefer machine, in which large sums of money were sunk, as they have been in the "Keely motor" and the like more recently.

This model consists of a horizontal circular table, with a central vertical shaft resting on a pivot-point below, and steadied by a journal in a frame-work above. Various inclined planes mounted on wheels rest on this circular table, and each inclined plane has on it a car containing a weight supported by a lever acting on the central shaft.

The inclined planes are also held in position by other levers similarly attached.

The operation is supposed to be as follows. The weighted cars trying to run down the inclined planes pull on the levers so as to turn the shaft and table round, so also do the inclined planes in their effort to escape from under the cars. The arrangement is admirably simple in more senses than one, but, wonderful to relate, it seems to work. If the weights are not on the cars the machine is at rest, but as soon as they are put in it starts off, and *under favorable conditions* will run indefinitely, but will stop as soon as the weights are taken out of the cars.

Here is a phenomenon which might well startle a novice, but yet he would do well to hold fast to his faith and insist upon a thorough investigation; for *this* is the inner structure of the machine:

A train of clockwork with a spring is concealed in the base, and can be wound up by a slight motion of one of the

* An address before the Graduating Class, Stevens Institute, delivered June 16, 1880.

ornaments on the frame of a glass case which covers and *locks up* the model beyond seeming possibility of tampering.

This clockwork drives a small plate on which rests the pivot of the central vertical shaft, and the various frictions are so adjusted that when the cars are loaded the weight so given will make the friction of the little plate sufficient to drive the shaft, but when the weights are removed this friction is too slight. An attendant once a day touching the outside case for a moment in pretense of dusting or the like, can keep it wound up perpetually.

A common method of managing such deceptions is to arrange the driving power so that it is communicated through some machine supposed to be driven by the reputed motor. In such a case the fraud was once detected by the observation that in a pair of gear wheels the teeth were polished by pressure and friction on the wrong side. Thus if of two wheels A drives B, the fronts of the teeth of A will bear upon the backs of the teeth of B, and in time the fronts of A's and backs of B's teeth will show wear; but if B is driving A, then it will be the fronts of B's teeth and backs of A's which show wear.

This actually occurred in the case of the Readhefer machine, to which I have just alluded. Mr. Readhefer applied to the Legislature of Pennsylvania for a grant of funds to carry out his great invention of perpetual motion, and a committee of experts, consisting of Messrs. Henry Voight, Robert Patterson, Nathan Sellers, Oliver Evans, Archibald Binney, Lewis Wermerag, Josiah White, and Samuel D. Ingham, was appointed to examine the matter. Mr. Nathan Sellers took his son Coleman with him, then a young lad, when he went to see the machine operated, and it is related that it was the young man whose sharp eyes and quick observation first perceived that the teeth of the gear wheels were polished on the wrong faces, and that he drew his father's attention to this circumstance.

This matter is so curious in many respects that I will here insert a copy of the resolution under which this commission acted:

Whereas, The interference of the Legislature of Pennsylvania in causing an inquiry to be made relative to the perfection or imperfection of newly invented machinery is not without precedent:

And whereas, It has been represented that Charles Readhefer, of the County of Philadelphia, has invented a machine declared not only by the inventor, but by many intelligent persons, to possess the power of self-motion;

And whereas, Should it be ascertained that these opinions are correctly founded, not only great honor would be conferred upon the Commonwealth, but incalculable advantages would be derived from the invention by the people of the United States especially, and by mankind in general;

And whereas, On the other hand, should the machine be found to be imperfect, the public interest would be promoted by exposing its fallacy;

And whereas, The Legislature of this Commonwealth reposes confidence in the integrity and qualifications of Henry Voight, Robert Patterson, Nathan Sellers, and Oliver Evans, of the City of Philadelphia; Archibald Binney, Lewis Wermerag, and Josiah White, of the County of Philadelphia; and Samuel D. Ingham, of the County of Bucks:

Therefore resolved, By the Senate and House of Representatives, of the Commonwealth of Pennsylvania, in General Assembly met, That Henry Voight, Robert Patterson, Nathan Sellers, Oliver Evans, Archibald Binney, Lewis Wermerag, Josiah White, and Samuel D. Ingham be, and they are hereby, requested to make a strict examination of the machine invented by Charles Readhefer, and to make specific representation respecting it as its alleged importance and the public expectation require.

Resolved, That the Secretary of the Commonwealth be, and is hereby, requested to transmit a copy of the foregoing preamble and resolution to each of the persons named therein, and also to Charles Readhefer.

(Sig.)

JOHN TOD,
Speaker of the House of Representatives.
P. C. LANE,
Speaker of the Senate.

In the House of Representatives, Dec. 14, 1812.
Read and adopted.
GEO. HECKERT,
Clerk of the House of Representatives.
In Senate, Dec. 17, 1812.
Read and adopted.
JOSIAH A. MCJIMSEY,
Clerk of the Senate.

Then follows the certificate of the Deputy Sec'y, and his letter to Nathan Sellers.

Sometimes some accidental circumstance will lead to detection.

About ten years ago a Mr. Paine had an electro-magnetic engine in Newark, in which many persons whose names are not unknown to fame, and who certainly ought to have known better, "took much stock" in the literal as well as figurative sense.

Being in Newark on some other business, I was waited upon by Mr. Paine and invited to see the machine. I accepted the risk (which I will presently explain) attending such a visit, and went with him.

The apparatus was shown off with great success, starting with full velocity the moment a connection was made with a little battery of four cells, driving lathes, sawing wood, etc., in a way that demonstrated several horse power, at least. I need hardly say that I was not convinced that perpetual motion had been discovered, but only looked out for the trick.

Nothing, however, could be demonstrated without taking the ponderous machinery to pieces. Near the end of my visit, however, in connection with a pseudo-explanation of some point, Mr. Paine once more connected the battery; whereupon the machine, in place of starting promptly as before, made a few turns and stopped.

This was, of course, accounted for by the inventor as caused by some derangement of parts, but as (a few minutes later) I went down stairs, I looked at my watch and found that it was five minutes after six o'clock. The building at large contained a steam engine, and power was *confessedly* used in all other parts except those occupied by Mr. Paine. This remarkable failure to start just about six o'clock, therefore, revealed the actual source of energy. The little battery, without doubt, operated either a belt shifter in a room below, or signaling a confederate similarly located for a like purpose.

Not long after, Mr. Paine and his electric engine were unsuccessfully sought for by some of his stockholders, and all that was found was a portion of the iron frame of the machine showing an interior passage for a belt to act on its axle from the room below.

The connection between the arrival of six o'clock and the stoppage of the motor which I had noticed in my visit, and had of course referred to its true cause, was thus fully demonstrated.

The risk to which I alluded in connection with such a visit is one of reputation. An ordinary sense of politeness hardly allows one, when visiting a man's workshop on his own invitation, to treat him as if he were a cheat and his statements as falsehoods, even if we so believe them to be; and thus one, from mere politeness, is almost sure to say something which may be quoted by interested parties as an indorsement; and such statements are very difficult to correct and explain, when they have once been put in circulation.

It is, therefore, a very good plan, when one is requested to look into such a matter, to decline unless an agreement is made that every interior detail of the machine shall be exposed to your inspection. In nine cases out of ten this will relieve you of any further solicitation.

On the other hand, to make any agreement not to reveal what you see, as was asked in some cases, as I know, in connection with the Keely motor, is of course what no sensible man would do, as it would make it possible to use his name in support of what he might have detected to be a fraud.

It may seem almost needless to say so much on the subject of these gross and conspicuous fallacies; but, while the stock of the Keely Motor Company, in the face of repeated exposures and years of unfulfilled promises, has to-day a value in the market; and when not only such daily papers as are notorious for their lack of truth, honor, or decency, but even respectable journals, will publish articles seriously advocating such plans, it is evident that even such fallacies need to be met and exposed by the intelligent engineer.

Besides these fallacies, which involve more or less intentional deception, we encounter others which are the result of perfectly honest, but none the less fatal, mistakes in observation or experiment.

A striking instance of this is furnished by one form of what is known as the aero-steam engine. This was a plan for admitting air into the cylinder of a steam engine at a certain point of the stroke, with a supposed gain in efficiency. A number of experiments were made within my own knowledge with a small engine, or, in fact, model, which seemed to demonstrate conclusively the advantage of this modification.

When the air was admitted, everything else remaining the same, the engine made twenty per cent. more revolutions in a minute against the same resistance.

This was, in fact, thought to be conclusive as to the advantage of the plan. On further investigation, however, it was found that the boiler supplying the steam engine was so inadequate that it could not fill the cylinder for a rapid stroke, and that thus an exhaust or back pressure occurred at each stroke when the engine was running fast. The admission of air at a certain point relieved this back pressure and actually increased the duty, but even when so increased it was inferior to what it should have been with a well-proportioned boiler.

This is, in fact, a type of a large class of fallacies one or another of which we encounter almost daily.

An inefficient or defective machine or process is taken as a standard, and some attachment or modification is made which greatly improves the result, and it is thence assumed that this attachment or modification would be of equal efficiency with machines or processes of the normal condition.

Thus, for example, a plan for blowing steam into the ash-pit of a boiler furnace was, many years ago, extensively advertised, and very remarkable testimonials were shown as to its actual efficiency.

On investigation it, however, turned out that these cases of success occurred where there was a great want of draught in the furnaces, and any means of increasing it would, therefore, have proved beneficial.

The steam blast was, however, a much less efficient way of increasing the draught than any of the well-known methods. Such an example teaches the importance of positive measurements in all cases, and the comparison of results with well-known and established standards.

Another example of a practical result apparently proving an efficiency which did not exist was brought to my attention, some time since, in connection with a pump which developed a pressure much beyond that which would be estimated by calculation of the force applied on the known area of its piston.

It turned out, however, that the piston was so loose that the water passed freely from one side to the other, and thus the pump acted only on the inward stroke, when the piston rod played the part of a plunger whose reduced section, as compared with the piston, accounted for the increased pressure obtained.

This condition of affairs was, of course, betrayed by the small amount of water delivered as soon as that was observed.

The lesson this teaches is, when a result is obtained at variance with established principles, don't look for a new law or a new force, but suspect an error of experiment or derangement of the machine.

Such examples as I have just cited teach us also another lesson, which may be embodied in a very brief maxim, which is this, "Never make two experiments at once."

That is, when you are investigating a subject and estimating the effect of this or that modification or improvement, never make two changes at once, for then you may easily assign the new result to the wrong one of the two possible causes.

Some remarkable examples of this error were furnished some twelve or fifteen years ago in connection with what then excited no small interest among steam users, namely, the "anti-incrustator." This consisted of a group of small magnets sustained by an insulating support in the steam space of a boiler and connected by a copper wire with the shell of the boiler at the other end. This was supposed to prevent the formation of scale in the boiler.

If unexceptionable certificates and the testimony of the most reliable witnesses as to practical results could have proved anything, this was thoroughly demonstrated to be an efficient apparatus. For several years it had a most successful career.

The stock of the company went up like that of some other more recent companies, and what is more, *stayed up*, and the anti-incrustators were put into boilers by the thousand. In a few years, however, with wonderful suddenness the anti-incrustator went out of favor and became a matter of history only.

To explain each instance of its success in operation would be, of course, impossible, but one prominent one will suffice as an example of a large class.

This was brought to my attention at the time by Mr. Coleman Sellers, of Philadelphia, who was one of the few who at that time declined to accept the evidence presented as sufficient to establish a claim itself intrinsically unscientific and improbable.

A friend of Mr. Sellers had tried some of these incrustators on boilers of his own, and, finding that they ceased to form scale, was convinced and took a large interest in the company.

In conversation with Mr. Sellers he stated this circumstance, whereupon he was asked: "Did you not make some other change at the same time." "None of any account," he replied. "To be sure, while the boiler was opened to put in the anti-incrustator, we took advantage of the opportunity to disconnect the mud drum, and in place of it connect the feed with a disused boiler alongside, which we employed as a feed water heater."

Now let me point out to you that one of the chief scale producing elements in the Philadelphia water is sulphate of lime, which is less soluble in hot than in cold water. With this fact before you, you will at once see that this gentleman had provided a most admirable "anti-incrustator" in his feed water heater. Here was a large mass of water so heated as to establish only gentle currents and with a slow circulation by reason of which the water remained in it a considerable time, and could thus deposit the sulphate of lime, as that became insoluble through the rising temperature. The sulphate of lime also, of course, carried down with it other suspended matters, as we all know it will under such conditions.

Here was a clear case of trying two experiments at once, and of assigning the result to the wrong cause.

Next to these, which may be called mechanical fallacies, we come to a more refined and abstruse class, which may be described as chemical fallacies.

Very many who may be quite able to see that no combination of levers, pulleys, wheels, etc., can make a machine operate itself without external supply of energy, or can convert one horse power into two, are not able so readily to see why a pound of coal may not be able to produce more than its regular equivalent of heat.

One of the forms of this fallacy which is most active at the present day is expressed with charming *naiveté* in an article appearing last March in the *Popular Science Monthly* with the title, "Water as Fuel," also in a paper read before the Engineers' Club, in Philadelphia, and published in the *Am. Gas Light Journal* of Feb. 16.

The leading fallacy developed in these articles is that involved in the title first quoted, "Water as Fuel."

To any one understanding the actual conditions this title would be even more absurd than such a one as "Ashes as Fuel," "Rest as a Source of Motion," or the like.

Water is simply the ashes of a perfect combustion, and is no more capable of becoming fuel than the most perfectly burned ashes from a wood or coal fire.

Fully to realize the true relation of this and other like matters, we must take a rather wide view of our chemical surroundings here as we live on the earth's surface.

We are surrounded by a practically unlimited supply of diluted oxygen in the form of the atmosphere, and all practical combustion must consist in a union of one or another fuel with this oxygen in the air.

While there are hundreds of other chemical combinations capable of producing heat, and which might with great propriety be called combustious, none but those involving the union of some fuel with atmospheric oxygen are practically available, and while from a purely philosophical stand point it is just as proper to call oxygen the fuel and coal the supporter of combustion, yet in their existing practical relations it is far more convenient and appropriate and fully as accurate to look upon atmospheric oxygen as the universal and freely supplied supporter of combustion, and coal, wood, and other materials capable of energetic union with it, as combustibles or fuels.

It is these for which we pay, and whose economical consumption is of importance, and the atmospheric oxygen may be safely taken for granted, with only such limitations as to secondary effects of its wasteful use as will, of course, be familiar to all of you.

Realizing this it will be evident that the value of any fuel depends primarily upon its capacity of uniting with the oxygen in the air, and that the addition to it of anything which does not possess such a capacity can in no way add to its heat-producing capacity, though, of course, it may render it more convenient of application in certain cases. To illustrate this:

Thus the heat energy in ordinary illuminating gas is by no means greater than that present in the coal from which it was made, but, on the contrary, is vastly less, yet, nevertheless, its convenience of application renders it actually more economical to apply it to a vast number of uses notwithstanding an immense loss of total heating capacity.

What, then, is the true office of water in its relation to fuel properly so called? Simply that of a vehicle, which, at a certain sacrifice of total efficiency, nevertheless facilitates the application of the heat energy (derived exclusively from the fuel) under certain circumstances.

In numerous cases solid fuel can not be brought conveniently in contact with the material to be heated, and then it may be desirable, even at a certain loss of total effect, to turn the solid fuel into a gas for the sake of this increased convenience of application and consequent special efficiency.

In such cases water may become a useful agency, but you can not too firmly fix in your minds the fact that its beneficial effects depend solely on this facility of application, and not by any possibility on any contribution by it to the total energy developed in the combustion of the fuel. The oxygen and hydrogen of the water have already developed in their mutual union all the potential energy they possessed in this relation, and before they can again exhibit any such force it must be supplied to them from some other source, such, for example, as the combustion of actual fuel, and then what they give out again will be exactly what was thus supplied to them and no more.

When, therefore, you encounter such statements as that by the use of water with coal the thermal equivalent of the carbon can be practically raised from a theoretical maximum of 14·300 heat units to a practical efficiency of 18·000 heat units, or that six pounds of carbon whose theoretical maximum is 85·800 heat units, can, by the aid of nine pounds of water, develop 124·000 heat units, do not mistrust your previous impressions, and fall into doubt as to the truth of the great theory of conservation of energy, but look out sharply for a fallacy in the reasoning which has led to such a conclusion.

Remember, in fact, that while nothing is so improbable that it might not be established by sufficient evidence, yet that the amount of evidence must be vastly increased when a seeming result is at variance with established laws, and that you will be well repaid for the closest scrutiny and the

utmost deliberation in all such cases by the avoidance of errors fatal to your prospects and reputation.

Another common source of error and consequent loss is the neglect in the consideration of a subject of what may sometimes seem trifling practical details, but which often control the question of success or failure.

Thus, for example, it was seen at quite an early date that a hot air engine was theoretically a more economical motor (if questions of practical detail were neglected) than a steam engine. Immense sums of money and a vast amount of the highest inventive genius have been expended on the development of such engines for general use.

The small practical details of excessive bulk in the machinery, consequent friction, the use of very high temperatures, and the like, have, however, limited the application of the air engine to a very narrow field.

In like manner, theoretically considered, the magneto-electric machine, deriving its exciting field of force from permanent magnets, is manifestly more economical than a dynamo-electric machine whose exciting field of force is maintained only by a constant expenditure of active energy. Yet, as a matter of fact, this theoretical economy is more than balanced by the practical impossibility of securing great intensity of magnetic field with permanent magnets, so that the losses caused by the greater friction and electric resistance present in the larger and more complex magneto-machines, are greater than those involved in the constant generation of a magnetic field by the use of an electric current in the dynamo machines.

There is another source of error which embraces not only engineering problems, but so much more that we might hesitate to restrict it by calling it a fallacy in engineering, but which, nevertheless, it behooves the young engineer to guard himself against.

That is, the confusion between the ideas of *force* and *energy*.

This fallacy has been very popular of late in certain connections, and has received the implied indorsement of some of the most conspicuous of modern scientific teachers.

To enter into its full discussion would be beyond our present limits of time, but let me at least draw your attention to this important feature. *Energy*, whether existing in an active form, as in the motion of a projectile, a moving train, or a rotating machine; or in a potential form, in a lifted weight, or two substances capable of chemical combination, is not a final cause, but is simply an effect of the grand, mysterious, unknown final cause called "force."

In order that the projectile, or the train, or the machine should possess actual energy by moving, they must have received motion from something having potential energy. Suppose this were in the simplest form of a raised weight, then *its* potential energy calls for the existence of the *force* of gravity.

Suppose the potential energy existed in the more recondite form of possible chemical combination: here again we must have the pre existent "*force*" of chemical attraction, and so on with every other imaginable instance. Wherever we find energy, we find the grand, unapproachable, cloud-wrapped mystery of "*force*" looming up behind it.

But, you may say, is not this *force* a known thing? We have many names of forces: "the force of gravity," "the force of magnetism," etc. Surely, scientific men know what force is!

Truly, some of them talk as if they did, and as if, like energy, it could be expressed as "a mode of motion." But not the ablest, and those who have really appreciated the question.

At the very opening of his grand work the "Mécanique Céleste," that greatest of scientists, La Place, says: "The nature of that singular modification, by means of which a body is transported from one place to another, is now and always will be unknown; it is denoted by the name of *force*."

Standing as it were upon the threshold of the celestial universe, and about to explain the grand laws of its mechan.cal arrangement by which the countless stars and suns and worlds sweep in their eternal and harmonious cycles, this great philosopher, with bowed head, acknowledges the incapacity of the human intellect to grasp the knowledge of *force*, which is yet the cause of all these motions and interactions whose laws and results he so fully explains.

With such an example as this, let us then avoid the fallacy of those who, through carelessness or want of consideration, confuse energy with *force*, and pretend to understand and explain the material universe on a purely physical basis, only because they ignore its great mystery, and acknowledge that, in the simplest phenomena of matter, we find a super-material and mysterious agency "whose ways are past finding out."

The correct discrimination between *energy* and *force* is something which is only now beginning to find its way into general scientific consideration.

Even Faraday had no idea of it, as we see from his paper on the "Conservation of Force," and many of the most popular of modern scientific teachers show that their ideas are very much confused in this relation; but the time is not far distant when this confusion will be cleared up and the true limits of energy defined.

When this is done we shall see that the idea of a material universe, in which matter is the origin of all and a sufficient final cause for existing phenomena, will be as absurd a hypothesis as that of a self-moving machine or of a self created animal.

Beware, then, of this fallacy as well as of the others which I have endeavored to indicate to you, and rest assured its acceptance would be as disastrous to your best interests as would that of any of those foolish fallacies which have led so many into disastrous failure.

EXPERIMENT OF MM. LONTIN AND DE FONVIELLE.

By M. JAMIN.

THE Ruhmkorff machine gives two sorts of currents, the one direct and the other inverse, which succeed each other alternatively and indefinitely at very short intervals. The direct current magnetizes the disk transversely. It is to be noted that in spite of the movement which the disk may have, this magnetization has always the same direction in space, but that it is variable in the disk. It does not adhere to the matter of the disk and cannot draw it along. But as soon as the direct current ceases there remains in the disk a permanent magnetization, which inheres in the matter of the disk and endows it with polarity.

NEW ENLARGING LENS FOR MAGIC LANTERN.*

To photography must be assigned a considerable share in procuring an enlarged field of usefulness for the lantern—the instrument said to have been invented so long ago as the thirteenth century, by Roger Bacon. It is no longer the toy, as in bygone ages, for the raising of specters, etc., but is daily gaining in favor with the public lecturer, who has discovered in it a ready means for the diffusion of knowledge. However, even in its present state it leaves much to be desired; for who has not witnessed the often-contorted and ill-defined pictures thrown upon the screen?

The practical application of the law of conjugate foci constitutes the principle of lantern construction, namely, the object or slide to be enlarged is placed in one of the conjugate foci of the lens, and the image or screen in the other; thus, for a larger image, the screen must be removed to a greater distance from, and the slide brought nearer to, the lens, and *vice versa*.

To obtain an enlarged picture of sufficient brilliancy, a lantern comprises three essential elements, namely:

1. A brilliant source of light. The illumination of the picture diminishes in the proportion of the square of the distance of screen or the size of enlargement. Thus, if at distance 1 the illumination equals one candle, then at distance 50 it is only one twenty-five-hundredth of that amount; in other words, if at distance 50 the picture is to appear as bright as it is at distance 1, we require 2,500 candles in place of one for the source of light. A case in point is when a three-inch picture is enlarged to twelve feet by means of a six-inch focus lens *without* a condenser.

2. A condenser to concentrate this light upon the picture or slide.

3. The lantern "front," or objective, to project an enlarged image upon the screen.

Years ago my attention was called to the necessity for a better lantern lens or objective, by one well known in the annals of photography. I refer to Mr. Latimer Clarke, the inventor of a stereoscopic camera known by his name, who employed the lantern for the purpose of amusing and instructing his children. I well remember being struck by the ingenuity of this gentleman in providing a plaster of Paris screen, made concave to suit the curvature of image produced by his lens. Though successful the dimensions of such a screen were necessarily limited; and hence his request for a better lens to project a well-defined image upon a flat screen of larger dimensions.

The problem presented for solution is by no means an easy one, and had it not been for a further incentive to the same end by another gentleman, still better known in photographic annals, the Rev. F. Hardwich, formerly Professor of Photographic Chemistry at King's College, the subject would, probably, have remained in abeyance—at least as far as I am concerned. The reverend gentleman, as far back as the year 1876, wrote me a first letter urging the importance of an improved lantern for public lecturers. In subsequent letters, in response to my application, he kindly furnished me with all the *desiderata*, and this has enabled me to complete my task.

I think I shall best meet the wishes of my audience if I give some of the valuable hints obtained, in Mr. Hardwich's own words, arranged under three heads:

First. The source of light, or the "radiant," as I shall term it. "The process I use is the oxyhydrogen or mixed gases; the perforation of the lime which shows the greatest intensity is about the size of a split pea. Then there is an outer circle of less luminosity, etc. I do not like to risk anything nearer than two and a half inches to three inches, if the thickness of the glass be considerable. I never had a fracture, but I take precautions for the sake of the lime cylinders as well as the condenser. First, I turn on the hydrogen only for three or four minutes, then enough oxygen to make the flame burn red for another three or four minutes, and after that the full amount of oxygen required for incandescence."

Second. *The Condenser.*—"The one I use does not bring the whole of the light to a focus. The lighted disk should be as white as possible. Quantity as well as quality of light is wanted in a new condenser. I have obtained the best results from the American or symmetrical condenser of four inches diameter and two inches solar focus (three inches equivalent), but I fully expect that you will go beyond it."

Third. *The Lens, or Objective.*—"For lecture halls a six-inch (equivalent focus) is a good size. The field should be flat, or nearly so. The practical point is a brilliantly-lighted picture of great size. A three-inch should be enlarged to (say) twelve feet. I cannot get beyond eight and a half feet; enlarged beyond that the pictures are not brilliant, especially at the edges, etc., etc. I noticed that in showing a spectrum on the screen to illustrate the rainbow the blue appeared green, and all the upper violet shades were destroyed."

Mr. Hardwich then recounts the difficulty experienced by him in procuring a good French lens, remarking that all the quarter-plate lenses sent to him to choose from were defective in flatness of field, the outsides being quite out of focus. He then became possessed of a half-plate French lens, which gave a flat field and admitted of much more latitude in the adjustment of the lime, an alteration in its position, further from, or nearer to, higher or lower, not sensibly affecting the disk, as compared with the quarter-plate lenses referred to. Tested for distortion upon a square border it proved to be of the hour-glass description, and the picture looked as though it were projected upon a slightly concave surface. He then refers to the advice so often given, namely, "to pick out a French lens with a flat field," concluding, "and that is precisely the weak point, as far as my experience goes."

With this ample summary of requirements before you I proceed to make a few remarks in the same order.

First, the source of light, or radiant. Theoretically this should be *a point*—at any rate it should be as small as possible, but intensely white or luminous. The nearest approach to such a source is the lime light, or the oxyhydrogen light referred to above; but even this is not a point. How much inferior, then, are the various kinds of lamps or lamp flames used for the purpose! I say nothing about the convenience or even sufficiency of such appliances for the illumination of small screens in private rooms, for they are undoubtedly safe. I am here concerned with the *best* source of light or radiant, and until electricity—the light of the future—is brought to our aid the lime light must be considered the best. I do not touch upon the subject of the proper methods for the production of this light, such as the preparation and storing of the gases, the best lime cylinders, the safety jets, etc., which I am not practically concerned. Moreover, I prefer to leave this part of the subject in abler hands, such as Mr. Hardwich's or other chemists familiar with the matter.

Assuming that we are in possession of the best radiant, we require something more in order to obtain a well-illuminated image upon the screen. Fig. 1 illustrates my meaning.

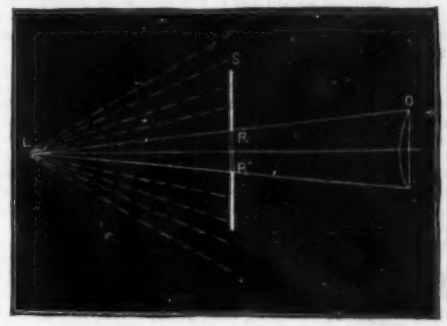


FIG. 1.

Let L represent the radiant, which sends out light in *all* directions; the diagram only exhibits one-sixth of these radiations. It illuminates the slide, S, represented in position, but only that portion of it situated between R and R' falls upon the objective, O; hence that small portion only is feebly illuminated and represented upon the screen. Now contrast the condition of things represented in Fig. 2, drawn to same scale.

Here the entire pencil of rays shown in Fig. 1 is concentrated upon or illuminates the slide, S, by means of the two plano-convex lenses, A and B, the condenser, and the objective, O, now receives light from every portion of the slide, the whole of the image being brilliantly illuminated upon the screen.

I pass by the single-lens condensers generally supplied with "toy" lanterns, inasmuch as they are almost devoid of correction, and only collect or condense a comparatively small amount of light upon the picture; nor shall I refer to the more complicated forms of condensers composed of three or more single lenses, nor to achromatized (!) ones—condensers said to collect angular pencils of 90°!

The condenser represented in Fig. 2 is of four inches di-

FIG. 2.

ameter and of three inches equivalent focal length, the radiant being at the same distance from the first lens, and including an angular pencil of 60°. To collect 90° requires for the same aperture an equivalent focus of little more than two inches; and when I mention the fact that the lenses composing such a condenser exceed the former by about one-third in thickness, the radiant of necessity occupying a position only removed one and three-quarter inches from the first lens, these conditions are obviously impracticable. Other things being equal, the amount of light collected by condensers is inversely proportional to the squares of their foci.

The commercial condensers may be comprised under two heads, namely, the so-called "Herschel" form,* composed of a plano-convex, or a concavo-convex combined with a double convex, the flat or concave side facing the radiant, the lenses of four inches diameter and three and a half inches equivalent focus; and the symmetrical condenser of three and a half inches and three inches focus respectively, and of the same diameters. I am disposed to give the preference to the latter form, resembling to some extent the Ramsden eyepiece, though this admits of improvement, as I shall show further on.

The essentials, then, of a good condenser are "quantity and quality of light." The former points to diameter and focal length, the latter to perfection of the glass and correction of aberrations of the lenses.

The condenser constructed by me for Mr. Hardwich is of four inches effective diameter, and two and three-quarters inches equivalent focal length. Assuming the radiant to be at a *safe* distance of two and three-quarters inches from the flat surface of the first lens, this condenser collects an angular pencil of about 66°, *i. e.*, about twenty per cent. more light than the shortest focus symmetrical. It is represented by Fig. 3, and consists of the two unsymmetrical lenses, A

FIG. 3.

and B. A is a plano-convex of flint three and five-eighths inches diameter, and B is a double convex of crown glass of four inches diameter. The lenses are mounted at a certain interval apart, with their deep sides facing each other. Approximate correction of chromatic aberration for centrical pencils is obtained by a proper apportioning of their focal lengths and the distance at which they are placed. Thus,

* A communication to the Photographic Society of Great Britain.

* I deem it right to state that the late Sir John Herschel never designed the forms of lenses called by his name as a "condenser." He proposed it as a "burning lens," the spherical aberration being approximately corrected only for the sun, or for parallel incident rays, as expressed in a letter addressed to the writer by the late Sir John Herschel, in February, 1867

ray, L R, after refraction by lens, A, diverges into a prismatic beam; this falls upon different parts of the lens, B, which, while acting upon the two extremes—the red and violet—in contrary directions to A, causes them to emerge parallel, the condition of achromatism, when they converge to the conjugate focus, *f*, about nine inches removed from B. The spherical aberration is reduced to a minimum by the forms of the lenses employed, *i. e.*, ray, L r, refracted by the central portion of the lenses, meets the axis at the same point, *f*, as the marginal rays, or nearly so.

I have decided upon a four-inch (effective) diameter condenser, since it fully illuminates the corners of a two and three-quarters inch square slide Of course a circular slide of three inches only requires a three and a half inch diameter condenser, of proportionately shorter focal length.

I need hardly say that the glass composing this condenser has been selected with especial care. It is perfectly limpid or colorless, and will remain so; it is free from *striæ* and air-bubbles, and has a perfect polish. In fact, it is Chance's best glass, the only drawback being its cost.

And here I would remark that any defects in the glass of the condenser are far more detrimental, as regards the purity and quality of the illuminated disk, than similar defects in the objective.

I pass on to the enlarging lens, or objective; for, however perfect the radiant and the condenser, the all-important thing for a perfect picture on the screen is the lens by which it is produced. Of these I have the honor of submitting two specimens especially constructed for the purpose. Before I describe the new lens I will briefly refer to those which have been used for the purpose up to the present time. There are the old, so-called lantern "fronts," comprising various single or achromatized lenses, that are made to screw one upon the other, giving all sorts of sizes and shapes of pictures, but devoid of almost all correction. These "toy" lantern appliances are, however, no longer in vogue with photographers, or indeed with any one who appreciates definition, freedom from distortion, etc., and hence came the substitution of *portrait* lenses for the old lantern fronts.

Those now supplied with the better class of instruments are generally French quarter plate lenses, mostly deficient, however, in respect of three very important particulars, namely, flatness of field, straightness of lines, and illumination. The former are seen at a glance upon the screen; not so, however, the latter. In order to illustrate my meaning I must (not to multiply diagrams) once again refer you to Fig. 2, representing the commercial four-inch condenser of three inches equivalent focus, the radiant at a distance of three inches with its conjugate of about ten inches, as at *f*. To collect and to transmit all the light at a distance of four and a half inches from the slide, as at O, requires a lens of two inches diameter in the clear. Upon examination of the French quarter plate lenses of four and a half inches back focus (six inches equivalent) it will be found that the lenses are of barely one five-eighths of an inch diameter, and this diameter squared affords the information that only about one-half of the light from the condenser passes through the lens on to the screen. It may suggest itself—Why not shorten the focus of the condenser by removing the radiant to a greater distance on the other side? The case is represented by the dotted lines, and it will be observed that for a shorter focus, as at *f'*, the radiant moves to L'. It is true the lens, O', now transmits all the light from the condenser, but this, in turn, receives less from the radiant, owing to increased distance; hence what is gained on one side is lost on the other, and the result is the same. Perhaps the balance of advantages is on the side of the latter expedient, since it excludes diffraction phenomena.

Then, again, it may be asked—Why not use a longer focus objective which includes all the light from the condenser? Take an extreme case represented by O^2, *i. e.*, a lens of double the focal length of O. This, of course, includes all the light, even from a larger radiant than a point; but observe, in order to get the same sized enlargement, the screen must be moved to double the distance, and the resulting picture appears dimly lighted. It possesses only one-quarter of the illumination of the former.

In my new lens I have endeavored to carry out the following essentials of a perfect lantern objective, namely, sufficient aperture or diameter of the back combination (in reality, the front of a lantern lens), approximately equal definition at the center and margins of the picture, freedom from distortion, and perfect achromatism. It is represented by Fig. 4 in position. In general outline it resembles my

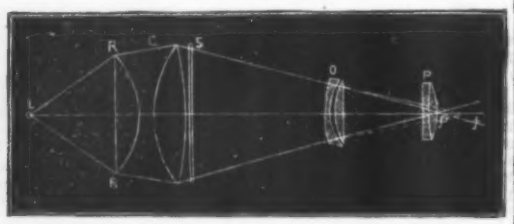


FIG. 4.

well known patent portrait lens. Combination O—the one next the slide—consists of a convexo-concave of flint and a convexo-concave of crown glass, the lenses being separated by a short interval. Their adjacent surfaces are of unequal radii, and externally the combination is a meniscus. It is of sufficiently large diameter to admit the entire converging cone of light transmitted through the slide of the condenser. Among the forms of lenses devised for the purpose (and I have constructed several) I find this to possess the greatest number of advantages. Considered as part of the condensing system it affords the means of correcting to a greater degree the positive aberrations, both spherical and chromatic, inherent in the condenser. The focus of the latter, after emergence from O, converges to the point, *f*—that is, very nearly the position of the front combination, P. This is a cemented compound externally of the meniscus form. Its focal length and radii of curvatures are so apportioned that, at a position of one diameter from O, it completes the correction of aberrations, and the rays diverging from it form a non-distorted, well defined image upon a flat screen. Combination P, as is apparent from the diagram, might have been made smaller in diameter. I have left it larger to ensure facilities for accurate workmanship. Also, should the radiant occupy a position slightly eccentrical with reference to its axis, the corresponding focus altering in position, then a larger diameter to transmit the entire pencil of light intact is required. As already stated, both combinations are achromatized for the visual ray, and by this means any colors that are in the slide are faithfully reproduced upon the screen; in other words, these lenses are intended for the lantern only, and not for photography, neither for the camera in the studio, the field, nor for enlarging purposes, the chemical and visual foci not being coincident.

At the present time I have constructed two of these lenses, viz., No. 1, of one and three-quarters inches diameter, the larger combination, intended for use with three and a half inch condensers of about three and a half inches equivalent focus, sufficiently large for a three inch circular slide. The other, No. 2, of two inches diameter and six inches equivalent focus, suitable for four inch condensers, or for two and three-quarters inch square slides. For the proper distance of screen or size of enlargement it is only necessary to divide the latter by the dimensions of the slide, and to multiply the quotient by the equivalent focal length of one or other of the lenses, *plus* one focal length. Thus, to obtain an enlargement of twelve feet diameter from a three inch circular slide, we require a distance of about twenty and a half feet for No. 1, and twenty-four and a half feet for No. 2 lens.

Obviously No. 2 lens is equally suitable for the smaller sized condenser, but it requires a greater distance of screen, and consequently does not give the same amount of light—a disadvantage to be set off against the probability of non-transmission of all the light from the condenser with No. 1 lens; hence, in case of doubt, No. 2 lens is to be preferred. It is hardly necessary for me to state that each objective or lantern lens must be used *intact*, and that good results are impossible with either one or other of the combinations used separately; that is to say, each objective affords but *one* focal length, and any increase or diminution in the size of the enlargement required must be obtained by an increase of distance, or the converse, between the lantern and the screen.

One remark about the proper position of the radiant from the condenser. The lime spot not being a point, but of considerably larger dimensions, the *proper* distance will at once be apparent on inspection of the edges of the disk, which appear yellow and ill-defined when the lime spot is too far off, and become white and sharp as that distance is diminished.

As regards the *mounting:* in a properly constructed lantern the radiant, the condenser, and the objective should have one and the *same axis.*

Thus much for description. I regret that I am unable to show you the new lenses in operation, since the covenants of the lease under which the society holds this gallery prohibit all lantern exhibitions. In the absence of this I must content myself with reporting the experience of the reverend gentlemen already referred to, who has used the instruments described for upwards of a twelvemonth. He writes thus: "I can imagine nothing better. With your condenser I get both light and sharpness; with your lens the picture appears as if received on a flat surface, well defined throughout. My object in exciting you to turn your attention to the optics of the lantern was to improve it and make it more useful to the public lecturer, and this we have undoubtedly accomplished."—*J. H. Dallmeyer, F.R.A.S.*

WIND PRESSURES.

MUCH attention has, since the fall of the Tay Bridge, been directed to questions concerning the pressure which the wind may exert on surfaces resisting it, and it has been complained that no adequate apparatus for testing it has been made. This is to some extent true. However, an instrument for registering the force and direction and character of wind has for many years been in constant use on the rifle range of the Royal Laboratory at the Royal Arsenal, which gives admirable results, and is hardly capable of getting seriously out of order or fouling, if reasonable care be bestowed upon it, and a description of this instrument can hardly fail to interest many of our readers. It was invented by the late Mr. Howlett, and is known by the name of How-

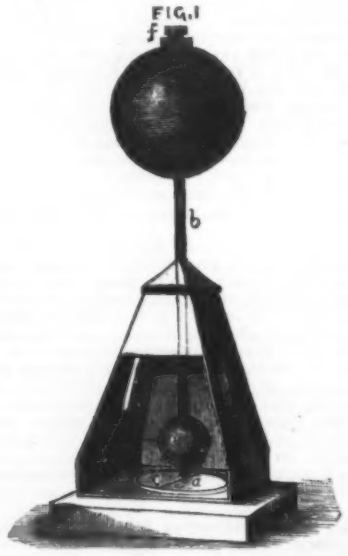


FIG. 1

lett's anemograph. It is described by the inventor as follows: "The cut herewith gives the general form of the instrument ready to be fixed on any convenient support which commands the horizon. The base of the instrument, *a*, is a slate 12 in. square and 1 in. thick, on which is engraved a circle 10 in. in diameter, divided into degrees, and figured from 0 to 360; upon this base is fixed a square pyramid made of zinc, having a window on each side and closed by a shutter. A brass tube, *b*, forming a lever, works in a gimbal as a fulcrum in the top of the pyramid. A pencil or tracer, *c*, of a proper weight works freely in the brass tube. *d* is a sphere 8·56 in. in diameter, that being the size of a sphere upon whose hemisphere the wind will press equal one-fifth of a square foot; so that if the sphere be drawn back by 1 lb., the deflection of the pencil, *c*, will represent a pressure of 5 lb. on a square foot. *e* is a weight so adjusted with reference to the sphere as to cause the pencil to express pounds of pressure on the square foot by its distance from the center of the graduated circle, according as the sphere is down, up, or up with a weight, *f*, at the top, thus giving three scales.

When the sphere is down, the scale of pressure is 0 to 20 lb. on the square foot; when up the scale is 0 to 5 lb.; and when up with the weight, *f*, on the scale is 0 to 2½ lb. A wooden measure graduated to these three scales, by actual trial, is attached to the instrument.

For ordinary registers kept daily all the year round, the sphere should be always down without the weight, *f*. The other two scales are for experiments, under personal superintendence, on light winds, which have never yet, it is believed, been investigated for want of an instrument that will give correct results. Some persons, however, prefer a pressure of 25 lb., and dispense with the other scales.

In action, the pencil throws out from the center, or zero, a line in the direction the wind comes from, and, in returning, a loop or curved line is formed, and the force of the wind is indicated by the length of the line or loop; so that by laying the wooden scale against the center of the slate and the end of the loop, the force is read on the edge in pounds pressure on the square foot, and the angle at which the currents of air crossed the meridian is at the same time found in degrees on the divided circle.

The greatest pressure here provided for is 20 lb. on the square foot, which is sufficient for the winds that occur in this country, as proved by careful experiments.

This instrument is strong enough to bear any hurricane; and to measure any force above 20 lb., nothing more is necessary than to increase the weight marked *e*, in Fig. 1, in a certain proportion.

Fig. 2 shows the flat slate upon which the instrument

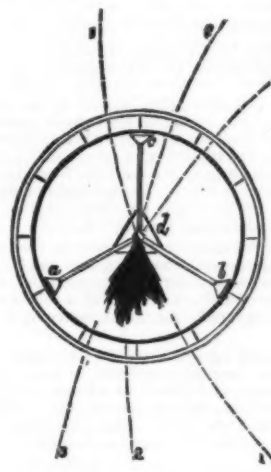
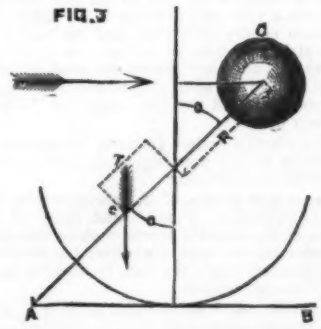


FIG. 2

works. The part in black represents the manner in which either a breeze or a storm is recorded, the salient points of which mark the direction and force of the principal currents, which are to be measured by applying the proper scale as before directed. But these black markings show a remarkable fact which this instrument offers to our contemplation, and which no other instrument has the power of showing.

If, while the wind is blowing, the pencil be held on the center of the slate, and then let go for a few seconds only, we get a figure consisting of several loops, as shown by the dark lines; from which probably no other conclusions can be drawn, than that the wind moves on in circles which are constantly crossing the paths of each other, as shown by the lines 1, 2, and 3. It appears almost certain that if a sufficient number of these instruments were employed in positions accurately marked on a map, and the times of the observations noted, the courses of these circles and their diameters might be laid down on a map, and so, by studying the small circles of a whirling breeze, a better knowledge of the law of storms could no doubt be obtained.

FIG. 3



In this figure is shown a contrivance by which the oscillation of the weight is prevented; *a*, *b*, *c* are three arms running upon wheels and working on a brass center pin that drops through a hole in the middle of the slate; *d* is an India-rubber band stretched on three hooks on the tops of the arms, forming a spring against which the returning pencil strikes back to the center.

Maps on common paper may be drawn by the instrument either with black lead pencil or blue chalk pencil; or they may be made on common paper by an agate tracing point working on carbon paper. The observer, therefore, can take his choice, either to look at the work on the slate, as done with the slate pencil, and then rub it out, or to obtain daily maps on paper, which would show in a striking manner the action of the air throughout the year; and the instrument also gives the power of trying experiments that it is hoped will some day lead to important discoveries. When paper is used, it is necessary to make a small cross cut in the center of the paper through which to pass the brass center pin before referred to. Of course the zinc cover of the instrument might be extended in such a way as to give shelter to the observer. In fixing the instrument of course the door must be put into a position where it may easily be got at; and then, if the meridian on the slate cannot be placed accurately on the true meridian of the station, that

meridian must be drawn on the slate, to which all the observations must be referred. In giving an order, instructions as to the meridian line should be stated. Provided the variation of the needle be accurately allowed for, the instrument may be readily placed on the meridian by means of a good square box compass.

The principal novelty of this instrument is, that a sphere is used instead of a flat pressure plate. The great circle of this sphere is the pressure plate, with the advantage of having the back of it guarded by a hemisphere, which prevents the formation of a vacuum by eddies. There will be, however, a small vacuum at the back of the sphere, the effect of which in light winds is not worth notice; and in a gale the pressure would not, perhaps, be exaggerated more than a pound per square foot."

The above is Mr. Howlett's own description, for the statements in which he of course is responsible. It would appear that the circles on the diagram have been obtained by actual practice, and there is a very valuable property belonging to certain instruments whose records are registered on a flat plane parallel to the force measured, and are governed by a resistance at right angles to it, viz., that the length of the line on the diagram is always in direct proportion theoretically to the strength of the force it records. Thus once learn that a line 1 in. long represents a certain force, then lines 2 in., 3 in., or ½ in. long, represent respectively twice, three times, or half that force. To prove this let the distance from C, Fig. 3, the center of the sphere on which the wind acts from the gimbal, be R. Next, since the instrument is made to fall and hang vertical when there is no wind, the center of gravity must be below the gimbal, or axis, say for example at *c* at a distance *r*; here, of course, the weight acts downward. Then let the wind blow the ball so as to bring the tube to any angle θ. The forces which balance each other are:

$$\text{Wind} \times \text{R} \cos.\ \theta = \text{weight } r \sin.\ \theta$$
$$\text{or } \text{Wind} \times \text{R} = \text{weight } r \tan.\ \theta.$$

In this equation the only variables are the Wind and tan. θ, and these therefore must be in direct proportion to each other, that is, when the wind is doubled the tangent becomes doubled, and so on. Now, the pencil by slipping out should draw the line from the foot of the perpendicular as far as A on the diagram, which line is the tangent, or as the tangent. Often the end at A only is perfectly marked.—*The Engineer.*

THE DURABILITY OF GUTTA PERCHA.

THERE are not many raw materials which have had a history so peculiar and important as gutta percha. Little did the English doctor, who while traveling in the Indian Archipelago in 1838, first observed the material in the form of an aboriginal ax-handle, dream that in the short space of twenty years it would become the means of enabling the old world to communicate with the new by means of the Atlantic telegraph, that highest triumph of human science.

It is perhaps not generally known that the probable value of gutta percha for telegraphic purposes was first suspected by Dr. C. W. Siemens, who happened to be present at a meeting of the Society of Arts in 1845, when it was first brought to England, and he dispatched a sample of it to his brother, Dr. Werner Siemens, of Berlin, to get its electric qualities thoroughly tested by the rude methods then available. About the same time Faraday examined the substance, which as our readers are doubtless aware is the juice or gum of the isonandra tree. Faraday found it to possess excellent insulating properties, while its readiness to melt at a comparatively low temperature, and its pliability and consistency when cool, marked it out as an insulator for telegraph wires laid either under ground or under water.

It was soon found, however, that the exposed surface of gutta percha covered wires laid under water became soft and gummy. Moreover, underground wires were subject to decay and consequent loss of insulation, especially in the neighborhood of oak trees; and a fungus was observed to make its appearance at these defective places, the probability being that the fungus and the decay proceeded from the same cause. The experience of cities shows that wherever the gutta percha covered wire is exposed to the air or moisture, and to changes of temperature, as at the joint-boxes for example, it is liable to decay; and hence it is the practice now to seal the joint-boxes as hermetically as possible. Lightning, too, is a frequent source of damage to underground wires, connecting aerial lines to offices; and in order to prevent its depredations lightning guards are inserted at the junction of the overhead and underground wires.

Rats, mice, and "such small deer," are in the habit of nibbling the gutta percha wires when they get into the pipes containing the latter; but quite recently a far more dangerous enemy, in the person of a minute insect, has been detected by Mr. W. H. Preece, chief electrician to the Post Office, as was recounted by him at a recent meeting of the Society of Telegraph Engineers.

For some time past the underground wires have failed in certain localities, for instance, London, South Wales between Chester and Holyhead, Dublin, and near Manchester. On examining the faulty wire, Mr. Preece found it beset by a small white insect scarcely visible to the naked eye; but which, under the microscope, very closely resembled a tiny white flea. Being provided with a kind of leaping pole or spring under the abdomen, it is able to spring about in the lively manner characteristic of its more civilized congener. Mr. Preece submitted one of these creatures for examination to Sir John Lubbock, an eminent authority in such matters, and he at once pronounced it a Templetonia crystallina, belonging to the Podura family. This family is well-known to microscopists; since a black member of it, the water flea, sometimes seen leaping about on roadway pools after rain, usually furnishes them with the scales which are employed as a test of the magnifying power of the microscope. Indeed the very insect in question, the crystalline variety, is a still more delicate test of microscopic powers. It is found abundantly in Kent, as Mr. Latimer Clark informed the meeting, and ordinarily lives on decaying vegetable matter, such as old leaves.

The fact that the Templetonia crystallina infests the wire at faulty places is not the only reason for believing these insects to be the cause of the faults. Examination of the wire shows it to be all bitten and nibbled away wherever it lay exposed to their attack, and on the other hand the underside of the wire, where it rested on the pipe containing it, is found to be untouched. Moreover, the body of the little animal is quite transparent, and it is, therefore, possible to see the dark crumbs of gutta percha, or what seems to be gutta percha, lying in its stomach.

Fortunately the places affected by the Templetonia are as yet few and far between, nevertheless it will be expedient to provide a means of stopping the ravages of the animal in future; and it may, therefore, be necessary to incase the wire in a pipe of lead. Perhaps there is some truth in the suggestion of Mr. Truman that the previous decay of the gutta percha from exposure to the air or other causes enticed the insect in the first place to eat it, and that were this primary cause removed the Templetonia would cease to molest the wire.

Gutta percha is so valuable in the arts, especially telegraphy, that, as the supply is ever getting scarcer, it is highly important to find means of preserving it from decay. Why it should decay on exposure to the air is not yet well understood; but it appears to suffer from oxidation. In chemical constitution it is a hydro-carbon (88 per cent. carbon, 12 per cent. hydrogen) containing very small percentages of oxygen, resin, and impurities. Mr. Truman has long been engaged in studying the causes of its deterioration, and he appears to have solved the problem at last, for he hinted in the discussion following Mr. Preece's paper that though not at liberty to reveal the matter then, he would make bold to say that very soon we should know the true reason why gutta percha decayed; and consequently be enabled to prevent its decay.

Be this as it may, experience has clearly demonstrated that if gutta percha is excluded from contact with the atmosphere, and from considerable changes of temperature, it remains practically imperishable. This is mainly proved by submarine cables laid on the bottom of the sea; but it is also found that underground wires of gutta percha wholly buried in close earth are as good at the end of years as when they were laid down. It is when gutta percha wires are laid in open pipes and joint boxes where the air enters that they decay. Wires buried in clay would probably be as indestructible as those laid in water.

This being so, the most obvious remedy is to exclude the air from wires. An interesting case of this kind of "water cure" was mentioned by Mr. Latimer Clark. Hitherto it has been the custom in laying the shore end of a submarine cable from the water's edge to the testing hut or station, to simply bury it in a trench dug in the ground; and we have seen this practice carried out even in tropical countries. Within the last year or two, however, Mr. Clark has introduced the plan (now carried out on nearly all the eastern cables) of laying the cable in a pipe kept full of water by means of a reservoir at the highest level. Another mode of excluding the air has been the application of prepared tapes overlying the gutta percha. Tapes of linen soaked in tar and paint, and tapes of lead and zinc have been tried, but the tar and paint injured the gutta percha. A more hopeful cover made by soaking tape in melted ozokerit, blended with a little pitch, and applied cold, so as not to soften the gutta percha, is now being tried by Mr. Bell; and as a contribution to the subject Mr. W. E. Ayrton mentioned the fact that in the laying of an underground line near Vienna lately the gutta percha covered wires were deposited in a trough and completely embedded in cement.

In America, where the manufacture of gutta percha has not been so well-developed as in England, it is not extensively used for underground wires, and the ingenuity of inventors there has tended to find substitutes for it in the "kerite" core, and the mode of insulation devised by Mr. David Brookes. This consists in wrapping the bare copper wire with clean unspun cotton or jute, and inclosing it in an iron tube which is kept full of purified paraffine oil by means of reservoirs giving a pressure sufficient to keep out moisture, for the oil alone will not do so. In order to get good insulation the jute should be free from vegetable acids and the oil from moisture. The wire is now largely employed by the Western Union Telegraph Company of America, for telephone and other lines underground, or laid along the roof. In the latter case the wires are inclosed in lead pipes, and deposited out of sight, thus obviating the use of unsightly poles and iron wires. The insulation resistance of the wires is about 200 megohms per mile at a temperature of 100 deg. Fahr. These facts were communicated to the meeting by Mr. Brookes himself, who is now in Europe trying his system in Brussels and Paris. In the course of his remarks he mentioned a curious fact which ought not to be omitted. It is that in working these telephone lines, centering in telephone exchanges, the induction noises so troublesome in telephony, are found to diminish the greater the number of lines in operation. That is to say, if of the total number of lines proceeding from the exchange only two are connected to the earth, and working, the induction will be far greater than if the whole lot were connected to earth for use.—*Engineering.*

NITROGEN IN IRON AND STEEL.

IN a paper read before the Chemical Society, London, Prof. Alfred H. Allen reaches the following experimental conclusions:

1. Commercial irons and steels contain nitrogen in such a form as to undergo conversion into ammonia by the action of steam or hydrochloric acid.

2. The solution method indicates a proportion of nitrogen in commercial iron and steel, varying from 0·0041 per cent. in spiegeleisen to 0·0172 per cent. in steel from Dannemora iron.

3. The solution process of estimating nitrogen gives closely concordant results on repetition.

4. The results obtained by the solution process are not affected by dissolving the metal with free access of air.

5. No nitrogen was present in the specimens of commercial aluminum, zinc, and nickel examined by the solution method, and but very small proportions were found in magnesium and sodium. Hence iron is exceptional in the proportion of nitrogen contained in it.

6. The iron reduced from the oxide by hydrogen differs from all varieties of the commercial metal by containing no trace of nitrogen.

7. No connection is distinctly traceable between the proportion of nitrogen in commercial iron and steel and that of carbon or other foreign elements.

8. There is no positive evidence as to its condition, but the probability is somewhat in favor of its existence as nitride of iron.

DEVELOPMENT OF ACETIC ACID IN BEER.

ACETIC acid is a product of the oxidation of alcohol, and is nearly always present in certain proportions in alcoholic liquids. Pure alcohol, even if very much diluted with pure water, does not, however, very readily oxidize. An open vessel containing dilute alcohol may be exposed to the atmosphere for a considerable time, and no change will take place beyond the evaporation of the spirit; but if in addition to the alcohol and spirit some other substances, such as are found in beer and wine, be present, then we have all the conditions favorable to the development of a peculiar organism—the Mycoderma aceti, which has the remarkable power of combining oxygen with alcohol and producing acetic acid. There is an intermediate product in this change called aldehyde; at all events, this body is formed when alcohol is acted upon by an insufficient quantity of the oxidizing agent. Aldehyde is a very volatile substance, possessing a peculiar fruity smell, and it is very probable that this body is formed, to some extent, when alcoholic liquids are slowly oxidized in contact with the atmosphere. The identification and isolation of aldehyde is attended with considerable difficulty, and therefore its presence is not easily detected in such a complex liquid as beer; but there is some reason for supposing that the peculiar aroma of some beers may be due to the development of small quantities of this body; at all events, the peculiar fruity smell of a fermenting gyle of beer certainly reminds one of aldehyde. If it is formed, it eagerly takes up a further quantity of oxygen, and is then converted into acetic acid.—*Brewers' Guardian.*

WASHINGTON TERRITORY.

THE following information concerning the resources, population, and general statistics of Washington Territory, has lately been issued by the Territorial Board of Immigration, at Olympia:

Washington Territory is bounded on the south by the middle channel of the Columbia River up as far as 46° north latitude; thence east along this parallel to its intersection with Snake River; thence down Snake River and north on the western boundary line of Idaho Territory, being 117° west longitude, to 49° north latitude; thence west on the parallel 49° north latitude, and down the middle channel of Canal de Haro and Strait of Juan de Fuca to the Pacific Ocean; thence southerly along the east shore of the Pacific Ocean to the mouth of the Columbia River, longitude 124° west of Greenwich, and containing an area of about 78,750 square miles.

This Territory is divided into two divisions by the Cascade Mountains (a continuation of the Sierra Nevada Range), known as Eastern and Western Washington.

CLIMATE OF WESTERN WASHINGTON.

Washington Territory has two separate and distinct climates, the western portion being mild and wonderfully uniform during the whole year. The average temperature during the summer or dry season is about 65°, and in winter 38°. The winter or rainy season commences about the middle of October, often later, and continues until April. Snow falls sometimes during the winter months, but soon disappears under the influence of the moist atmosphere. For a few days in summer the mercury sometimes reaches 90° between 11 A.M. and 3 P.M., but this is only of short duration, and is always succeeded by cool nights and refreshing sleep. Generally during the winter months grass remains green and continues to grow, and often flowers are in bloom in the gardens all winter. The average rainfall on Puget Sound is about 50 inches.

CLIMATE OF EASTERN WASHINGTON.

In this portion of the Territory greater extremes of heat and cold are experienced, and yet, compared with the same latitude east, the climate is exceedingly mild, corresponding with that of Maryland. During July and August the mercury sometimes ascends to 95° and 100° in the shade, but seldom drops to zero in the winter. During the four seasons of the year the average temperature is of 52° in the spring, 73° in summer, 53° in autumn, and 34° in winter, with some snow, which lasts generally but a few weeks at most.

Stock is seldom fed or sheltered, living through the winter on "bunch grass" and white sage. The annual rainfall south of Snake River is about 18 inches, increasing gradually north of that point. The summer is always dry from June to September, and often until October, insuring to the farmer a most reliable harvest and thrashing season for securing his grain.

ARABLE AND TIMBER LANDS.

The different classes of land in Western Washington have been estimated as follows: Timber, 20,000,000 acres; prairie and gravely plains, 10,000,000 acres; and rich alluvial bottoms, 5,000,000 acres, or a total aggregate of 35 000,000 acres of land. Almost every section of the best timbered land contains more or less rich alluvial land along the streams, and many of the highest hills produce, when cleared of the timber, from two to four tons of hay per acre.

The unparalleled excellence of the Puget Sound timber for ship building and other purposes is now too well known throughout the markets of the world to require more than a brief mention. Timber can be obtained of almost any required dimensions, either in length or diameter, from the red and yellow firs of the Puget Sound basin and Lower Columbia or its tributaries. These trees grow to an enormous size and height, often 250 to 300 feet high, and from 6 to 10 feet in diameter, and generally as straight as an arrow. The varieties rank in the following order, viz: Fir, cedar, hemlock, spruce, maple, alder, ash, and cottonwood, with many other varieties of smaller growth too numerous to mention.

EASTERN WASHINGTON—EXTENT OF ARABLE LANDS.

In the valley of the Columbia, exclusive of the present Indian reservations and the Blue Mountain district, there are over 500 townships of land. Estimating each township at 22,500 acres, which is 540 acres less than a full township, and the result is 11,250,000 acres. Allowing one-half of this area to be more suitable for pastoral than agricultural purposes, on account of inferior quality and objectionable surface formations, and we have in round numbers 5,625,000 acres of arable land. The timber in Eastern Washington, found along the slopes of the mountains, is generally pine of a scrubby growth, with some belts of tamarack, fir, and cedar.

PRODUCTIONS, ETC.

All the cereals, vegetables, fruits, and berries, grown within the temperate zone are raised in this Territory. The average yield per acre of wheat, oats, barley, rye, and vegetables, cannot be surpassed in any portion of the United States. The great wheat region is in Eastern Washington. The area of wheat land in the counties of Walla Walla, Columbia, Witman, Stevens, Yakima, and Klickitat, is estimated to be 5,000,000 acres, with a productive capacity of one hundred million bushels per annum. The average yield of wheat per acre is twenty-five bushels. The present season it is thirty bushels per acre. Many fields have produced more than fifty bushels per acre. The yield of wheat this year will exceed 2,000,000 bushels, most of which will be shipped to Portland, Oregon, and from thence to foreign markets.

MINERAL RESOURCES.

Coal is our present leading mineral production, and is only found, at this time, in the Puget Sound basin and on some of the tributaries of the Lower Columbia. No doubt now exists of the extent of the coal fields of Western Washington. The streams show evidence of coal in almost every direction, often cutting through seams of over twenty feet in thickness. The area of this field is over 20,000 square miles.

Limestone is also found extensively, and of excellent quality, on San Juan and Orcas Islands Puyallup, Touchet, and Grand Ronde Rivers. Copper, lead, and iron ores are known to exist in several localities, but are as yet undeveloped.

Gold and silver also exist in the Territory, although their development thus far has been quite limited: Recent discoveries of placer gold, which have been made on the Skagit River, in Western Washington, are now attracting considerable attention. Quartz mining is carried on to some extent in Eastern Washington. The total production of gold during the present year is estimated to be $300,000.

Deposits of bog iron have recently been found in Jefferson county. It is claimed that the deposits are quite extensive, and that the value of the iron has been fully proven by analysis.

MANUFACTURING INTERESTS.

In the Puget Sound basin this branch of industry is principally confined to lumber. The twelve largest saw-mills have a capacity of from 50,000 to 200,000 feet daily, and the annual production of lumber is from 250,000,000 to 300,000,000 feet, nearly all of which is shipped to San Francisco, South America, and the Sandwich Islands.

The manufacture of staves and furniture is also receiving attention, for which there is abundant material and a good market.

EXPORTS.

In addition to the exports of wheat already referred to, there have also been large exports of other cereals, wool, flour, and live stock from Eastern Washington. Large shipments of flour have been made direct from Walla Walla to Liverpool. From the lower counties on the Columbia River there have also been exportations of grain and canned salmon; of the latter, 100,000 cases of forty-eight cans each.

From Puget Sound the exports have been lumber, coal, fish, grain, potatoes, wool, hops, hides, barrels, lime, etc. The export of coal for the past year has been 190,000 tons.

The lumbering interests are somewhat depressed at present, owing to a falling off in the foreign demand. This depression is regarded as temporary only. The quantity exported the past year has been about 150,000,000 feet.

INLAND NAVIGATION.

But few, if any, of the States or Territories in the United States have better natural advantages for the transportation of their productions to market than Washington Territory. Within its limits at present there are over 1,000 miles of inland navigation, so equally distributed that but small portions of the Territory are very remote from navigable waters.

RAILROADS.

There are now 230 miles of completed railroads in this Territory—157 miles of the standard gauge and 70 miles of three feet gauge—with now a bright promise of an early completion of the Northern Pacific Railroad from the mouth of Snake River, where the work of grading is already commenced, to Lake Pend d'Oreille, a distance of nearly 200 miles, through a naturally rich and productive country.

POPULATION.

The population of the Territory on the 1st of May last was 57,764. This shows an increase over the preceding year of 7,273, or about 14 per cent. Immigration has been quite large during the past summer, and the estimated population at present is 65,000.

The assessed valuation returned for 1880 is $21,021,832, which is no doubt much below the real value.

HOW TO REACH WASHINGTON TERRITORY.

To persons wishing to come to the Territory, the easiest and quickest route is by San Francisco, California, and thence by steamship to Puget Sound, or the Columbia River; or for the eastern portion of the Territory, a man may purchase a through ticket at Omaha, by rail to Kelton and thence by stage coach to Walla Walla—from Kelton to Walla Walla is about 500 miles. Persons desirous of bringing with them all their old home outfit in wagons, had better come to Kelton by rail, and thence by their own teams into Eastern Washington.

PRICE OF LAND.

There is plenty of land to be taken up under the United States land laws, or purchased from the Northern Pacific Railroad Company, but it is not the best policy for new comers to be in a hurry to acquire land. It is plenty, some of it useless, some of it too hard to clear to be of any present value, and much that can be taken without price by homestead, or at $1.25 to $2.50 per acre by pre-emption entry at the United States Land Office, or $2.60 per acre at the N. P. R. R. Company's Land Offices, that is actually worth $50 per acre to the man who will cultivate and improve it. He could not sell at that price, land is so plenty, but still it is worth that sum to the actual settler upon it who will keep it for his own use. Such is the desirable land to get hold of.

GENERAL REMARKS.

The time for laboring men to commence making themselves homes is in the winter season, when business in the many industries is partially suspended. At this time men sometimes find themselves out of employment, but if they are men who have husbanded their gains through the summer, this time may be employed in preparing for themselves homes on the Government land, and it will count more to them if judiciously employed, than if given to another for ordinary hire.

Salaried men here, as elsewhere, do not always save their earnings, and in many instances, the larger the salaries obtained the smaller seems to be the gain, which is true the world over. The opening of spring is the time for the laboring man to arrive here who desires immediate work. Any of the towns require a quantity of trades work. Tradesmen get from $2 to $3 a day, while the common laborer receives from $30 to $60 per month, and say, for a man who is not capable of hard work, or a boy, $15 to $20 per month.

Washington Territory has an unequaled climate for comfort and healthfulness. Rate of mortality, 1 in 238.

Over 50 species of flowering plants indigenous to the Territory. Fish plentiful in its waters. It has the finest harbors in the world. It is profusely watered by rivers. Twenty navigable rivers. It has good schools and school laws, and churches of all denominations. Washington Territory wants industrious men and women—no room for loafers.

[We think there is either an error in the rate of mortality above given, which is less than 5 per 1,000, or the sick people go out of the Territory in order to die.]

THE SOUTH PACIFIC ISLANDS.

"CAPTAIN" is writing an interesting series of letters from the missionary ship, Morning Star, which recently completed a cruise of 13,493 miles in the Micronesian Islands, anchoring fifty-eight times, and visiting twenty-six different islands, transferring two hundred and fifty-one passengers. Of that part of the Gilbert group known as the Marshall Islands, this writer says:

"The archipelago consists of two chains of islands running northwest and southeast. They extend from latitude 4° 40' to 12° N., and from the longitude of 173° 5' to 165° 22' E. The Radack chain has fifteen, and the Ralick chain thirteen islands. The natives have been in the past a desperate people, cutting off vessels that visited them and murdering all the crew. Vessels now sail through this entire group, running in and out of the lagoons, dropping their anchors as near as possible to the largest villages as fearlessly as would be done among the Hawaiian Islands. In all the group there is probably no land over seven feet above the water. They are all of coral formation, and, like those of the Gilbert group, each reef has more or less islets upon it. As we sail north through the group, it is very noticeable that each succeeding reef has upon it less land and trees, until reaching the northernmost reefs we find generally but small islets, and those covered only with low bushes.

"After coming from the Gilbert Islands, there seems to be plenty of room for all the inhabitants here. The estimate placed upon the present population is between eight and nine thousand. We find a smaller race here than in the Gilbert Islands, and one more pleasing to meet and with whom a greater security is felt. The women especially are quite attractive when covered with the pretty mats which they neatly and dextrously make and border with different colors. The men dress with the usual skirt or maro about the waist, made by stripping down the hibiscus bark into small strips, which, when new and clean, gives them a dressed-up appearance. The government is that of chiefs. They range from the high chief to the lowest of a chiefish family, and, what is singular, the descent of rank is by the mother instead of the father.

"The products seem much the same upon all coral islands. Here are the cocoa nuts, pandanus, and bread fruit, more abundant, however, than upon many of the Pacific Islands. The pandanus, as well as the bread fruit, is an important article. Like the bread fruit, it is prepared and kept for future use.

"The Marshall Islanders may properly be called the seafaring people of the Pacific, and some of their voyages in their large proas or canoes are extraordinary. In the construction of their large seagoing canoes they display great talent. They are constructed from the wood of the bread-fruit tree; and, when the few poor tools they have to work with are taken into consideration, it adds respect for their ingenuity. A long time is spent in the construction. The tree has first to be cut down, and then, not having saws to split it, the long process of clubbing it down to the shape of planks is commenced. After the planks are in shape comes the more delicate work of fitting tightly together the edges of the planking. When that is done, having no nails to keep the planks together, small holes are bored into each plank about two inches from the edge, through which they pass cord made by their own hands from the fiber of the cocoanut husk, and thus fasten them securely together. After the canoe is together, if we stand at either end and glance along the sides, we will observe that one side is perfectly flat and the other convex. Upon the latter side a large outrigger is placed, extending many feet from the side of the proa. When they wish to tack, instead of turning the canoe to the wind, the three-cornered sail and helmsman are shifted to the opposite end. This keeps the outrigger always to windward. Some of these proas are eight and ten feet deep, and capable of carrying fifty and seventy-five men. They sail very swiftly and very near the wind. It is only the work of a moment to reef their sails by an ingenious arrangement of brails, much like those used upon Chinese sails.

"In this group large fleets of proas are almost constantly going from island to island. They provision with cocoa nuts, mar, pandanus, and taro, and by trailing a fishhook astern they also catch many fish, which it does not trouble them to eat at once without any cooking, and the cocoa-nut water answers every purpose to quench their thirst. They have been known to drift four and five months without seeing land. They seem to navigate by instinct, as of course they know nothing of systematic navigation, not even using a compass, but steering by stars and the swell of the sea. In starting on a voyage these canoes separate one from another far enough to keep the next one on either side in view, which gives them a wide range of the ocean and reduces the danger of passing any island without a sight of it, and in case of accident assistance is near.

"The Marshall Islands can also boast of their hydrographers. We have seen their charts, which are remarkably accurate, and which in the absence of others would be of assistance to us. They are constructed by tying together small limber sticks—some in straight lines—which represent currents and waves, and where these lines meet, a small stone or pebble, according to the size of the island they wish to represent, is fastened.

"In comparing the positions with those on our own charts, they strike us being so nearly alike that it seems impossible that it could have been done by instinct or memory

"The most promising pupils from the schools of the group are now to be selected and taken to the training-school at Kusaie, where they will be away from the influences of their low and degraded homes."

NEW EXPERIMENTS ON MAGNETIC ATTRACTIONS.

By M ADER.

AMONG the bodies examined, such as wood, paper, etc., elder pith is most sensibly attracted by the magnet. With a Jamin magnet capable of supporting 100 kilos, the author has been able to attract a ball of elder pith at a distance of 0·002 meter.

A HAWAIIAN ALMANAC.

REMEMBERING that, in the history of the Sandwich Islands, only 100 years ago their barbarian inhabitants clubbed Captain Cook to death, the sight of a well-printed "Hawaiian Almanac and Annual for 18°0," with many pages of smart advertisements, and a complete court calendar, gives rise to very strange feelings. Neither our Australian colonies nor the United States afford any parallel to the progress of the Sandwich Islands; in the former cases the civilization is simply an offshoot and continuation of that of England; in the latter it is the natives themselves who, in the short space of a century, have advanced from primitive barbarism to the necessity for an almanac. This almanac covers 76 pages, besides advertisements, the latter affording a pretty fair criterion of the stage of civilization already attained in these islands. Here the attractions of a variety of restaurants, refreshment, coffee, and billiard saloons are set forth; the "Palace ice-cream parlors" at No. 60 Hotel street, Honolulu, seem to be rather an inviting resort in a place where the weather is always hot; watches and clocks have already become a necessity, and the latest things in upholstery and household furniture have found their way to Honolulu, which also boasts of at least one wagon and carriage builder. One confectioner and pastrycook vaunts the richness and flavor of his wedding cakes, while appropriately in the next page we are told where a plentiful supply of drugs, medicines, and Havana cigars may be obtained. The cards of attorneys-at-law and stock brokers give evidence of the complexity of Hawaiian civilization, and the tourist need be at no loss for hotels and "pleasant furnished rooms." A reading-room gives access to the principal periodicals of the world, upwards of 100 of which are set down in a news-agents' book as being regularly supplied to his customers. Indeed, it would be difficult to name any article in demand in civilized society that could not be supplied at one or other of the various stores and warehouses in Honolulu. When we look in the almanac itself we find it contains pretty much the same kind of information to be found in the almanacs of countries where civilization began 1,000 or more years ago. Hawaii has a fair supply of public holidays, including characteristically, the Chinese New year, and, we are pleased to see, the birthday of our gracious Queen. A full list of the church days and movable feasts is given, a list of the kings of Hawaii, their birth, accession, etc., from Kamehameha I., who began to reign in 17°2. There is a complete court calendar, as minute as any of the Court lists in the "Gotha Almanac," with the king, queen, the princes and princesses, ministers, law dignitaries, governors, etc. There is, moreover, much useful information as to population, inter-island and inland distances, heights of mountains, imports and exports, shipping, and other statistics. The regulations for carriages and rates of fares are quite as minute and as hard on the "cabbies" as those of London or Paris. All this, with some special articles relating to the islands, the royal family, and Hawaiian folklore renders the "Hawaiian Almanac" of peculiarly suggestive interest. It is sad to think that a people who have shown themselves capable of such rapid progress should be as rapidly dying out. That this is so the various censuses give unmistakable evidence. At the census of 1832 the total population was 130,313; in 1878 it had dwindled down to 57,985, and of this number only 44,088 were native, and 3,420 half-caste, the remainder being foreigners. Of the foreigners, the Chinese are by far the most numerous, numbering 5,916.—*London Times.*

THE PRESERVATION OF TIMBER.

By J. W. PUTNAM, Associate A.S.C.E.

IN January, 1869, work was commenced on the construction of a line of railroad between New Orleans and Mobile. The road extends for nearly fifty miles through a flat, marshy country, crossing various streams and bayous, which are at certain seasons of the year tidal and infested by the *Teredo Navalis*. From thence to Mobile it passes through a higher sandy country, crossing several tributaries to and arms of the Gulf, also salt, in which the ravages of the teredo are very great. The bridges over all the waterways were constructed on pile foundations. Yellow pine was generally though not always used for piles, and driven soon after being cut. During the months of May and June, 1869, a part of the piles were driven for the bridge across Bay St. Louis, a sheet of salt water two miles wide, and the work was then suspended until the following fall and winter, when the bridge was completed. During the succeeding November, or in less than nine months from the completion of the bridge, the piles began to give way and break off, being thoroughly honeycombed. A few weeks later the piles began to break in the bridge over Bay Biloxi—a bridge one and one-fourth miles long—and during the month of April following it broke down, letting an engine and four freight cars into the bay. The work of rebuilding was begun during the winter of 1870 and 1871, or within two years of the time of turning the first shovelful of earth in the construction of the road. The Bay St. Louis bridge was built on piles sheathed with yellow metal, and the Biloxi bridge on piles sheathed with zinc. The piles were hewn to one foot diameter, covered with a layer of felt, and then with the metal, the whole being securely nailed. The other bridges were not entirely rebuilt at that time, but had new piles driven underneath and sprung into position. In the Pascagoula and Pearl Rivers—streams from twenty to fifty feet deep, and having very strong currents during the spring floods—piles were perforated by the teredo from within five or six feet of the surface of the water to the bottom, and some of them were found to be cut completely off. The sheathing was found to be an efficient protection for the piles as long as it remained intact, but the waters of these harbors were found to contain something which, uniting with both kinds of metal, dissolved and rendered them worthless in a few years. The yellow metal lasted about twice as long as the zinc.

With the great number of bridges subject to the attacks of the *Teredo Navalis* the contest was now seen to be one of life or death.

The *Teredo Navalis* is an inhabitant of salt or brackish waters, and lives within timber, the most of which has been carried out to sea by rivers. Hence, it is not probable that it would inhabit the waters of a rainless coast.

It is of translucent and jelly-like consistence, varying in size from a creature invisible to the naked eye to one, two, or more feet in length, with a diameter of five-eighths of an inch. I have been informed that specimens one inch in diameter and four feet long have been taken from the planking of ships.

It seems to grow about two inches in length a month, and appears to live from eight to sixteen months. Between March and May the greater part of the old ones disappear.

The young make their appearance in March, but do not become abundant until May, and continue to develop until November. It is a solitary animal, living in a cell alone, and having no communication with its fellows. It is probably hermaphrodite, and like other low forms of life, is very prolific, a single one depositing from one to three million eggs in a season. The eggs, I think, are only hatched by the action of salt water, as no young appear when the water is fresh by reason of rain. The eggs have been supposed to hatch within a week of their deposition in water, but I think they often remain much longer, and perhaps some of them pass the entire winter afloat. Having been hatched, they swim about in search of food, and in this condition millions of them must be carried out to sea by ebbing tides and distributed to other ports, or perish by starvation.

If they come in contact with timber which suits their taste, they attach themselves by a foot or sucker and enter, making their way by means of a pair of forceps-like cutters. The cutters are a pair of concave or partly spherical shells placed on each side of the head, and extending partly over it. They are joined by a hinge-like joint at one end and free at the other, and are moved by a firm, strong muscle, which is attached to the lower edge. In the center of the head, and between the free edges of the cutters, is a firm muscular foot or sucker, by which the animal holds itself in position for work. Beneath the free ends of the cutters is the mouth or orifice leading to the stomach, to which further reference will be made.

The hole cut for entrance is very minute, so small as to be seen only by the closest observation. Having entered the timber and begun to feed, they enlarge rapidly. The cavity cut is lined with a shelly deposit of carbonate of lime, to which the animal is attached near the point of entrance by a muscular coat and the skin, shutting out all water except that taken through canals in the body for respiration and lime. At the tail are two oar-shaped bones or shells, the blades of which are ribbed like a file, the long, round ends extending inside the body. By means of the muscular coat attached to the lining shell it is enabled to project these file-like bones outside the timber, thus removing obstructions, maintaining communication with the water, and enlarging the orifice to meet the increasing demands of the growing animal. It may also serve as a protection against the depredations of other animals by closing the orifice and presenting a front of solid lime. In fact, I do not see how any animal can attack it without first being able to tear down its armament. Should an entrance be attempted while the bones are drawn in, at the first alarm they would be forced out, and being tapering, the intruder would find himself in a vice-like trap from which it would be difficult to escape.

In the operation of feeding, the teredo places its foot or sucker against the wood. The two muscles move the cutters like a pair of forceps or scrapers. The chips are carried to the orifice or mouth before referred to, and thence to the stomach. Open an animal freshly taken from the water, press the stomach, and the contents will flow out through the mouth. Place these under a powerful microscope, and the cuttings are plainly discernible.

The stomach is a brown, oblong sac, a little below the head. From its lower end extends a long intestine or alimentary canal. This passes about one-fourth the length of the animal downward, and turning in a loop, passes back to the head, where it forms another loop beneath the foot or sucker, and then passing downward the entire length of the animal, discharges at the orifice between the two file-like bones at the tail. This connection may be traced in some of the specimens exhibited to the society. From this it will be seen that the teredo cuts timber for food, and not as a burrow. I have also noticed that on coming in contact with timber not suitable it retracts one-fourth, more or less, of its length, and abandoning its old cell, cuts a branch in another direction, always taking care to build a large dam or wall across the entrance to the abandoned cell. I have seen three different branches cut by the same animal.

I do not see why the teredo has generally been supposed to cut with a rotary motion. Any one who will take the trouble to sharpen the end of a pipe, and place in the center a soft, elastic point, and revolve the pipe forward and back, will see the value of such a cutter.

Beside the canal or duct mentioned, there are others, extending from the vital organs to the orifice, which I have not traced out and examined as thoroughly as desirable. The ovary is a large gland situated between the stomach and first loop in the intestine. It becomes enlarged and active in the winter and early spring in animals which have attained any considerable size. I have reached no satisfactory conclusion on the subject of their reproduction, and will only give a brief resume of observations.

Early in March a few animals may be found which have just entered the timber. As the season progresses the number which have just entered increases until the first of October. From that time the number decreases rapidly until the last of November. Through December and January I find none. Having entered the timber they grow in length about two inches a month. In February and March the largest animals are found. I have taken them out measuring twenty-three inches, and large numbers can be found at this season from fifteen to eighteen inches in length, with the ovary so filled with eggs that the smallest part pressed between two glasses in a microscope magnifying three hundred and fifty diameters will show from thirty to a hundred in a single field. I have estimated that a single ovary would contain three million eggs. During April the large animals all disappear, and only the smaller ones up to four or six inches in length remain.

I do not think clear fresh water necessarily destructive to them, as I have seen the water of the bays along the coast fresh enough for good drinking purposes by reason of heavy and continual rains for two or three months, and yet they appeared healthy and vigorous. I have reliable information that vessels have been taken up the Mississippi River to New Orleans—over a hundred miles—during the low stage of the river, when but little sediment was carried, and tied up for the purpose of killing the worms; but when placed in the dry docks two or three months later the worms were found to be in an unprofitably healthy and vigorous condition. If the water be roily, or loaded with silt from heavy rains, it will probably destroy them. During heavy rains, and while the water is fresh, I have not found young animals entering timber, and have supposed that the eggs are only hatched by the action of salt water, as some seeds will only germinate under peculiar conditions.

It has been supposed that the teredo leaves the timber in search of other fields. This probably comes from the sudden disappearance of large numbers in the spring. As they are attached to the shell so firmly as to exclude the entrance of water, they can no more leave it than can the oyster its shell. Having fulfilled their mission they die, and from their soft, boneless construction they rapidly decompose, and are washed away, leaving only their shell and cutters. The rapid destruction of timber in exposed situations by decay, and the ravages of land and marine animals, have led people in every age to devise measures to prevent such waste of time and means, and render their works more enduring. The Egyptians—famous for their work in stone—buried their kings in coffins of wood that will endure until those grand old pyramids shall crumble to dust. They saturated their planks with what appears to have been a hydrocarbon or asphaltic oil, and they have stood the test of the few thousand years that have passed since they were prepared.

Modern investigators have plowed a wide field in search of something which would be equally effective and comparatively inexpensive. Hundreds of patents have been secured, and with a flourish of trumpets, some have been put to use, only to run a brief race and quietly subside.

Perhaps the only preparation that has stood the test is a hydrocarbon, a product of the destructive distillation of coal. About the year 1835 experiments were begun with this product, usually called creosote or dead oil. It is rich in phenols, but its greatest ingredient is naphthaline. In the scramble for work, and from a mistaken idea that cheapness of construction is economy, as well as by errors of judgment, much defective work has been done. In some cases such work has given partial satisfaction by increased length of service, while in others the additional outlay has been entirely thrown away, bringing disrepute upon all classes of creosoted timber.

Certain rules have been adopted by engineers in the selection and use of timber, which, while valuable in the use of untreated timber, should be set aside in the use of creosoted material. For instance, in ordinary timber-work for exposed situations, compact, solid heart timber is usually specified, and the cutting and framing, more or less, done on the ground.

Such timber, if treated, will prove difficult to saturate. The soft and unripened growth, or sap-wood, more readily absorbs oil, and becomes the more durable. I am satisfied that the more porous and destructible classes of timber now considered nearly worthless, will, when creosoted, become the most valuable. Fir, swamp ash, and old field pine, when treated, will outlast the best white oak, yellow pine, or cedar uncreosoted. In ordinary use the heart of yellow pine will more than six times outlast the sap-wood. I have at West Pascagoula pieces of yellow pine, the sap-wood of which was partially saturated with creosote oil in October and November, 1872, and which since then have been exposed to contact with the earth, and unfavorable climatic conditions. Such parts as received oil are as perfectly sound as when cut from the stump, while the untreated sap, and a considerable part of the heart, are entirely rotten.

Timber which, untreated, would decay in one season, will remain in closely packed piles or on the ground, in the most unfavorable conditions, perfectly sound for years.

As far as practicable all cutting and framing of timber should be done before treatment, except in open, porous timber, which has been thoroughly saturated. Holes for bolts may be made if they are fitted so as to exclude water. Ordinary building timber will not be thoroughly saturated, and too much care cannot be taken in this respect.

From what I have seen of creosoting, I consider timber which has been saturated with coal-tar oil practically indestructible, and as durable as iron or stone. There is a property in the oil which prevents fermentation and the change which we call decay. How much oil per cubic foot of timber is necessary to produce this result I have not determined. If a small quantity—say five to ten pounds per cubic foot—could be evenly distributed through the stick, it might be sufficient. But as the oil first comes in contact with the outside of the timber the central part will receive none until the outside has become thoroughly saturated. No method is known by which a given quantity of oil less than the total amount which would be absorbed by timber can be so distributed as to reach every part. The amount which can be forced into timber varies from eight to forty pounds per cubic foot. This last amount can only be forced into very light and porous timber.

The unequal results from creosoting timber probably come from the unequal distribution of the oil.

"Of the ties that were treated with creosote oil and laid on the Great Eastern Railroad in England in 1841, eighty per cent. were still doing service in 1862, a period of twenty-one years."

No statement is made as to whether the ties that failed had been thoroughly treated or not. A close examination and report of such conditions would greatly enlighten the public as to the actual value of different kinds of timber and the process of creosoting.

As a defense against the ravages of the *Teredo navalis*, or ship worm, I think coal-tar oil is invulnerable. It is deadly to cold-blooded animals. A small quantity stirred in a pool where there are fish will kill them. I have placed pieces of treated timber in water where the worms were abundant, and though rapidly entering other timber they would not touch that which had been creosoted.

I have taken pieces of timber, and saturating a part of each one, have left the remainder free from oil. The teredo would enter and destroy the untreated parts, and perish for want of food, leaving the treated parts perfectly good. Wherever it came in contact with the creosoted wood it turned away.

A piece of creosoted plank was inserted in the bottom of a skiff. When the untreated part of the skiff was honeycombed and worthless the treated plank had not been touched.

The bottoms of boats may be protected by drying them and applying what creosote they will absorb.

Water does not unite with the oil, consequently the oil remains in the timber an indefinite length of time.

If this oil be poured in a running stream it will roll along the bottom like molten lead or quicksilver.

A large number of reports on the subject of creosoting, by civil engineers in Europe, have been published during the last fifteen or twenty years, bearing witness to the value of coal-tar oil for the protection of timber against the ravages of land and marine animals. Where the work of creosoting has been properly done piles have stood thirty and forty years, and are still good. Untreated timber, in the same places, would only have stood from two to six years.

From the difficulty of submarine examinations the faithful, thorough creosoting of submerged timber is of more importance, if possible, than where prevention of decay alone is desired.

The trustees for the bondholders of the New Orleans and Mobile Railroad had become so thoroughly convinced of the value of coal-tar oil as a preventive of decay in timber—which takes place rapidly in the long, warm seasons of that latitude, and of the ravages of the teredo, which is abundant and destructive to the numerous and long bridges which cross the bays and inlets along their line—that they decided in the winter of 1874–5 to creosote the piles and timber used in bridge construction. As no works could be found in this country treating timber thoroughly enough to be satisfactory, it was thought advisable to build machinery and do the work on a plan different from any then in operation. Accordingly, works were erected at West Pascagoula, Miss., at a cost of about fifty thousand dollars, and all the bridges and waterways on the road have been constructed of creosoted timber, except the long spans of trusses, which are of iron.

The work has been eminently satisfactory. Pile piers have been built which bid fair to outlast their iron superstructure.

These works contain two reservoir tanks for storing oil, placed in the ground; two tanks for treating timber, six feet diameter inside by one hundred feet long; a large tubular condenser and pump for supplying it with water, a large vacuum pump, an oil pump, a powerful force pump, a hoisting engine for handling timber, a pair of boilers capable of furnishing the required steam, and a superheater. These are all connected by the requisite pipes and valves.

Each treating tank contains nearly five thousand feet of one-inch pipe arranged in coils, through which super-heated steam is passed for seasoning timber, and also iron rails upon which cars loaded with timber are moved in and out. Both heads of the treating-tanks are movable. At suitable distances are transfer-derricks for loading and unloading timber. A large number of piles, ninety and ninety-five feet long, have been handled with them.

In work, piles are cleaned of dirt and bark, butted and sharpened, and timber cut and framed ready to be put in position. It is then loaded on iron cars, built for the purpose, and hauled into the tank.

Steam is then turned in through a perforated pipe extending along the inside at the bottom of the tank.

This is continued until the timber has become heated through. The vapor is then condensed, and a partial vacuum produced. Super-heated steam is passed continually through the coils of pipe to vaporize the sap and moisture contained in the timber, and as fast as vaporized it is condensed. A partial vacuum being maintained, the moisture vaporizes at a low temperature, and the seasoning proceeds rapidly.

When the timber has become properly seasoned the tank is filled with oil and a pressure applied by means of the pressure-pump of from one hundred and fifty to two hundred pounds per square inch. This pressure is maintained until the pressure-gauge remains constant, showing that the timber will absorb no more oil.

The oil is then drawn off, the load drawn out, and another load which has meanwhile been prepared drawn in and the process repeated.

The consumption of oil by this process has usually been from twelve to eighteen pounds per cubic foot, or from one and one-fourth gallons to two gallons per cubic foot.

Over three gallons per cubic foot have been injected in some loads.

The main features of our plan of treatment are the extraction of the sap or moisture in the timber to prevent fermentation, and also to provide room for oil. Timber can no more be steamed dry than it could be seasoned by boiling. The timber, being cooler than steam, would condense and absorb it, thus accumulating moisture. Water cannot be drawn out of timber by a vacuum alone. If timber retained its moisture by atmospheric pressure, then by removing such pressure it would flow out. But moisture is retained in timber by capillary attraction, which is left in full force when atmospheric pressure is removed. We steam timber to heat it through as being the simplest method of conveying heat; then condense the steam and pump out the air to produce a partial vacuum.

It is well known that water vaporizes in a vacuum at a low temperature. While under pressure the degree of heat at which it vaporizes rises to correspond with the pressure applied. By maintaining a partial vacuum we are enabled to vaporize the moisture rapidly, and at a temperature which will not injure the timber. When the pressure is removed by condensation, the heat absorbed by the timber during the steaming expands the moisture by vaporizing and drives it out. Superheated steam is passed through the coils of one-inch pipe in the treating-tank to maintain the temperature and assist in vaporizing the moisture, and as fast as vaporized the moisture is drawn away by the condenser.

This process is continued until the timber has become satisfactorily seasoned, when the tank is filled with oil and a pressure of from one hundred and fifty to two hundred pounds per square inch is applied until the timber will absorb no more oil.

It is now nearly four years since the construction of bridges with creosoted timbers was commenced, and during that time not a fire has caught in the new work from passing trains, while on bridges constructed of uncreosoted timber watchmen were a continual necessity. In this respect we are happily disappointed.

THE CULTIVATION OF BARLEY.

THE cultivation of chevalier barley in Lower Alsace is now carried on on the most improved principles, with the result of producing grain which can hardly be equaled in any part of the world. The average weight of Alsatian barley is, from the determinations of numerous brewers and maltsters, 61·85 kilogrammes per hectoliter (=49½ lb. per bushel); the average weight of 155 lots of the chevalier barley grown in that province was, on the other hand, 68,555 kilogrammes per hectoliter (=55 lb. per bushel). The following particulars relate to a field of winter barley cultivated by M. Gruber, the well-known brewer of Königshoffen. The area of the field was 18 ares (=2·178 acres). The seed was sown broadcast on the 14th of November, 1878, under the scarifier followed by the harrow, at the rate of 200 liters per hectare (=2¼ bushels per acre). The barley succeeded two successive crops of potatoes, of which the first had received an application of 25,000 kilogrammes per hectare (=10 tons per acre) of farmyard manure; no other manure was applied to the barley. The nature of the soil was a heavy calcareous clay, with a sub-soil of the same composition. The yield was 2,370 kilogrammes of grain per hectare (=2,025 lb. per acre), and of straw, 2,370 kilogrammes per hectare (=2,114 lb. per acre). The weight of the grain was 71½ kilogrammes per hectoliter (=57½ lb. per bushel).

STIMULATING DRINKS.

A "STIMULANT" is quite a comparative term. Meat is a stimulant compared with vegetables, and warm food a stimulant when compared with cold. The more monotonous existence is, as a rule, the greater the demand for something or other to stir the flagging energies; while the ennui of idleness also creates a spurious desire for something stimulating. Thus, all the world over, besides the more spirituous liquors that kindle wit and wauken' lear, or the milder wines that begin by letting out the wit and end by keeping it out, we have numberless decoctions that owe their stimulating qualities sometimes to inherent semi-spirituous or pungent properties, at other times merely to being hot infusions. In Manchester, and many other parts of Lancashire and the Northern counties, nettle beer is as well known and appreciated as ginger pop. We have also known ladies indulge in the innocent dissipation of drinking decoctions of black currant jam in each other's rooms a-night.

In Egypt a sweet drink called Khooshaf consists of water with raisins boiled in it and sugar added. When cool, a little rose water is dropped into it. They have also many sherbets, besides lemonade. The most esteemed is prepared from a hard conserve of violets, made by pounding violet flowers, and then boiling them with sugar. This violet sherbet is of a green color. A sherbet is prepared from mulberries, another from sorrel; one is made from raisins, one from a strong infusion of licorice root, and another from the fruit of the locust tree.

Tiste is a cooling draught, composed of water, sugar, and roasted Indian corn flour and chocolate, which is commonly used throughout Nicaragua, and of which native travelers always carry a sufficient supply. They also make a cooling drink from the seeds of the calabash tree (*Crescentia alata*).

In Asia Minor ginger tea, sweet and hotly-spiced, is said to be excellent; and a drink composed of hot water and sugar, flavored with ginger and spice, is the drink the Khurds break their fasts with in the Ramazans. The so-called "Mongol wine" is only skimmed milk subjected to vinous fermentation and distilled through a rude apparatus. Flavor and odor are said to be alike insipid. According to M. A. Bechamp, from the moment when milk is drawn from the cow, alcohol is found in the milk, and the quantity goes on increasing as the milk is kept.

The Fort Rupert Indians make a most curious drink thus: they gather the berries of the vaccinium in the summer before they are quite ripe, and press them into a firm cake about half an inch thick; this is carefully dried in the sun and wrapped in bark. About five ounces of this cake, when to be used, are placed in a large vessel and a little cold water added. It is then stirred rapidly round and round with the hand, squeezed, and worked into a paste-like form; then more water added, and the rapid stirring continued. It now begins to look exactly like soapsuds, and the more it is worked about the more frothy it becomes. In this frothy state it is drunk. It is said to have a disagreeably bitter flavor.

There are two varieties of Labrador tea plant, an infusion of which helped to eke out the scanty suppers of Franklin's crew. One is *Ledum vatifolium*, the other *L. palustre*. The first is an evergreen, growing three feet high, which inhabit swamps. It is boiled overnight, and, being thus well steeped, is used warm next morning, and is said to be very wholesome and pleasant by those who like it or are obliged to use it. It is universally spread over the Arctic circle. "The leaves are oblong, reflicate on the margin, of a brownish green above, and iron rust color beneath, with five stamens equal in length to the corolla." Dr. Richardson considers *L. palustre* as the better substitute.

In the Brazilian Highlands Burton talks of a tree called Pau Jahu, of the blossoms of which the Jartanejas make tea. The Falkland Island tea plant is a little species of myrtle frequently used as a substitute for tea by sealers.

A common beverage with the Indians of Chili is parched meal and water. In Scotland oatmeal and water was a universal and most wholesome harvest drink, far superior to the wretched stuff known as "harvest beer," now generally substituted.

In South America a wine is made from oranges. The oranges are carefully collected by hand, and then exposed to the sun for three or four days. They are then cut into slices without being peeled, and the juice having been squeezed out by twisting the woolen cloth in which the slices are placed, is left undisturbed for twenty-four hours. The essential-oil which swims on the top is skimmed off with a spoon or absorbed with a plug of cotton. To every twenty-five pounds of liquid is added twenty pounds of brandy 18° above proof, and twelve pounds of sirup of sugar. This mixture is thoroughly stirred up and put in jars or pots, which are covered up with wood and lime and buried two feet in the ground. At the end of two months the orange wine may be drunk; but its quality, like that of most wines, improves with age.

Various nations make wine from rice. By the Chinese and Tartars it is soaked in water several days, boiled, fermented, drawn off clear, and put in earthen jars. The Japanese call a similar liquor saké. It is tolerably bright, says a traveler, and not a little resembles wine, although its taste is somewhat singular, and not very palatable. When fresh it is whitish. It is always drunk warm by the Japanese, and when taken in any quantity soon inebriates them; but its effects vanish in a few minutes, and are generally succeeded by a disagreeable headache. Wallace mentions that in Borneo a large jar of rice wine, very sour, but with an agreeable flavor, was handed round.

In Newfoundland beer is made from the *Pinus nigra*, or black spruce, not a very large tree. From its boughs or sprays, essence of spruce, in Canada, and spruce beer, the common beverage of Newfoundland, are made. They simply boil the sprays and smaller branches, adding molasses and yeast, and let the whole ferment for a day or two. It is highly salutary to those living on salt fish and other salted provisions.

The junipers (*Juniperus communis*), the gin juniper, two feet high, and the savine (*J. sabina*), six inches high, grow in the clefts of rocks all over Newfoundland and Labrador, and yield a strong, wholesome, hard berry used in making spruce beer. The buds and bark of the American mountain ash (*Pyrus Americana*) have the taste of bitter almonds, from the acid contained, says Bonnycastle, which is stated to render them suitable for making noyau.

A decoction of the leaves of the wild licorice (*Abrus precatorius*) is used in the West Indies in place of tea. Instead of Chinese tea—which they boil, in the Mongolian fashion, with milk and butter—the common people among the Kalmuks gather in the deserts a kind of small licorice, which they boil with salt and milk.

Wine is made in Southern Russia from the juice of the walnut tree. As a substitute for tea the poorer Chinese sometimes use an infusion of dried fern leaves, and Davis found those commonly used for the purpose near the Poyang Lake. In New Zealand Cook found a species of *Philadelphus* growing on the eminences which jut out into the sea. Its leaves they drank as tea, and found it to have an excellent taste and smell, and to be an excellent substitute for Chinese.

The celebrated brick tea of Russia is made from the refuse leaves and stalks of the plant, mixed with sheep's blood and then compressed into slab-like bricks. The tea is flavored with mare's milk somewhat salted. A similar idea is the tea tablets brought out recently in this country. They are said to be much less in bulk per pound, of increased strength, and consequently cheaper than ordinary tea, while it will preserve the properties of tea under any change of climate.

The sarsaparilla or sweet tea plant of the Australian colonists (*Smilax glyciphylla*) is common near Sydney. A decoction of this plant would form an excellent beverage for the laboring class during the sultry summer months, and one well-suited to the climate, says Bennett. A strong liquor is distilled from the root of the tiplant in Otaheite, while the rairo is also used in the preparation of a fermented paste called poi, in great request among the natives.

In New Zealand the tupakihi (or *Coriara sarmentosa*) is indigenous. The fruit is a small berry of a shining black color when ripe, full of a dark-red juice of a sweet taste, and free from any injurious property, but the seeds are poisonous. The natives, therefore, having expressed the juice, strain it before they drink it. The missionaries at Paihai, Bay of Islands, make an agreeable wine from berries, which tastes like that made from elderberries.

In Africa, Werne states that vinegar was truly welcome to him as a most refreshing beverage, although causing thirst afterward. In Yemen, in Arabia, coffee is rarely used, as in their opinion it heats the blood; but of the husks or shells of the coffee they prepare a liquor in the manner of tea.

In Mexico the May-hey furnishes the natives with thread for linen and cordage, and also a balsam and liquor which, when fermented, is as pleasant and strong as wine. From this, too, a strong spirit is distilled not unlike brandy. They have a sour liquor in Norway which they drink with greater pleasure than either beer or brandy. It is made by an infusion of juniper berries and a grain like lentils which grow there in plenty.

In Russia the common drink of the peasant is quass, a fermented drink, something like sweet wort, made by pouring warm water on rye or barley meal. It is considered an excellent anti-scorbutic. Schweinfurth speaks of plantain wine as an extremely palatable and wholesome drink obtained after being allowed to ferment for twenty-four hours.

One of the great staples of the Manhes on the Amazons is the guarana. This vine—a trailing plant somewhat like the high-bush blackberry of America—is about eight feet high when full grown, with a bean the size of a coffee bean, two being inclosed in an envelope, according to Agassiz, three according to Browne. This bean, roasted, is pounded in a mortar with water until it becomes a compact paste. This dries in shapes, when they become hard and resemble long, straight brown sausages. This substance, called guarana, is grated on the rough tongue of the pirarucu—a large fish—and a teaspoonful, with sugar, in a tumbler of water, produces a very grateful, cooling drink, which has the effect of allaying nervous headaches. It is also administered with excellent results in d'arrhea. It is extensively used in parts of Brazil as well as in Bolivia, mainly as a drink in place of tea on the Amazons.

Paraguay tea yerba or yerba mate is a kind of tea in great repute throughout South America, especially among the country people, who drink it at all their meals and whenever they have nothing particular to do. It is the leaf of a shrub (*Ilex Paraguanensis*) extensively cultivated in Paraguay and the Brazils, says Beerbohm, while Robertson states that it is brought principally from the woods one hundred and fifty miles above Assumption. The peons cut the twigs and leaves from the trees, scorch them in two processes, and grind them to powder in a wooden mill. It is then packed in damp bulls' hides holding upward of two hundred pounds, and these, drying in the sun, become as dense and as hard almost as a stone. The powdered leaf is steeped in boiling water, and imbibed through a thin pipe (bombilla) perforated with holes, so as to prevent the fine herb from being sucked up with the fluid.

Returning home, we find that the commonest drinks in many parts of England are cider and perry, made from apples and pears, the percentage of alcohol in which varies from five and a half to nine. Hereford is noted for sweet, and Devon for rough cider. In the rough cider, according to one account, the saccharine matter is destroyed, but retained partially in the sweet by checking the vinous fermentation. The best apples are small, with an acid or astringent taste. They are spread out in heaps to mellow; then they must be crushed uniformly, as the color depends on the crushing of the rind and the flavor of the pips. After strongly pressing, the juice is allowed to ferment and, we are told, the barrels are left without bungs until the following spring, when they are tightly closed. Charlemagne ordered his judges to provide competent brewers of cider, perry, and mead, this latter formerly a favorite drink with the northern nations.

In Madagascar they, too, make a honey wine, a composition of three parts water to one of honey, which they boil together and skim after it is reduced to three-fourths. They afterward put it to ferment in large pots of black earth. This wine has a pleasant tartish taste, but is too luscious. The wine they make of sugar cane is still more unwholesome.

In Abyssinia, Bruce makes them take five or six quarts of water to one of honey. These they mix together in a jar, and throw into it a handful of parched barley meal; after this they put into it some chips of a wood called sards, which in two or three days takes off the cloying taste of the honey and makes it very wholesome and palatable. Parkyns calls the wood tsaddoo, a sort of bitter bark; or they use "geso," a bitter herb, which are analogous to hops in beer. The criterion of its being ready is that the liquor has fermented to such a degree as to have nearly lost its original sweetness.

The seeds of the kerkedan roasted are used as a substitute for coffee in Nubia. The "soua" or beer of Abyssinia is made thus: Dagonsha flour is made into a dough with water, and left to ferment for two or three weeks. During this time it is fumigated with the smoke of various woods called, in Tiger, tursos, agam, owleh, mabte, tchandak, etc. The dough is then divided into cakes and baked on a flat iron. The day after a mixture of barley flour and water is made, which, together with the cakes, is put into a large jar of water, a small quantity of the bitter "geso" being added. After being allowed to remain quiet for a few hours, the beer is fit for drinking.

The Basutos make a beer thus: The grain is left to sprout, when it is then ground, and enough boiling water poured upon it to make a paste. When cold, water and yeast are added, and when it has fermented for two or three days, the liquid is placed on the fire and boiled several times to strengthen it. For the same purpose they add a few handfuls of fresh flour when it is afterward strained.

In Brazil a beverage is made from the berries of the Assui palm. They are about the size of cranberries, and dark brown. When boiled and crushed, the juice strained has the consistency of chocolate, and a dark purplish tint. It has a sweetish taste, says Agassiz, and is very nice eaten with sugar and the crisp farinha d'ague from the Mandioc.

In China the wine they use is by no means agreeable; it is always taken hot, and in this state it approaches pretty nearly to Madeira in color, and a little in taste as well. It is not very strong. Another traveler says that their jars of wine, or rather vinous liquor, was of a yellowish color by no means pellucid, and of an acescent quality. It was greatly disliked by Europeans.

Formerly British wines of varied character were made after special recipes by every housewife of any pretensions. These varied from parsnip and cowslip to wine from elderberries and elder flowers, and covered a motley list. Sugar was always added to give strength to our sourish northern products and enable the liquor to keep. Burton beer may be said to have banished private concoctions, along with the once favorite strong ales of the north.—*Glasgow Herald.*

AN ADVANCE IN THERAPEUTICS.

THE editorial corps of the *Chicago Medical Gazette*, and especially Dr. Clevenger, have been carefully investigating the chemical and physical behavior of the mercurials. The conclusion arrived at seems to be, stated broadly, that all of these preparations not originally simply mixtures of metallic mercury with other substances are reduced completely in the organism, giving rise to millions of minute globules of mercury which are pushed and float about in the circulating fluids of the body. These statements are not put forward simply as the legitimate deductions from a theory, but as facts ascertained by actual examination of the blood of animals to which calomel or other mercurials had been given by microscopes of high power. In the case of the simple mixtures of metallic mercury, as blue mass, mercurial ointment, etc., the metal enters the circulation in obedience to physical laws, and in accordance therewith wanders about throughout the organism until it is finally expelled in the same simple condition in which it entered. The authors endeavor to explain its therapeutic action by its physical properties, but in this respect we think their explanation hardly satisfactory. Their philosophy on this point is in substance that the globules of mercury, by their gravity and mobility, push morbific matter through the capillaries, thus preventing its lodgment and securing its destruction by oxidation in the blood or its elimination by the excretory organs.—*Chicago Pharmacist and Chemist.*

THE STRANGER WITHIN THY GATES.

UNDER the Mosaic system of government the amplest provision, looking to the conditions of life in those times, was made for personal and social hygiene. The code of morals and cleanliness did not overlook the stranger within the gate, although he was generally a bond slave, and therefore not entitled to the highest consideration. For his own good, and for the sake of those in whose midst he lived, care was bestowed on him. We have changed all this. Modern civilization, in its refinement, is becoming fairly solicitous for the public health, and, with commendable prudence, is beginning to place the customs and surroundings of domestic life under reasonable control; but we have not yet realized the fatuity of leaving the stranger within our gates wholly out of the sanitary scheme! With rare exceptions, the heads of even well regulated households do not deem it necessary to enforce habits of personal cleanliness upon their domestic servants. Probably they know almost nothing of their menials. They are strangers when they are admitted into the household, and strangers they remain. We sicken at the thought of an Irish peasant keeping a pig in his hovel, and allowing it to feed off the same platter with his children; while at the moment we have in our houses, in the closest association with the young and most susceptible members of our firesides, men and women who, for aught we know, possibly wash only at long intervals, seldom change their under clothing, and in their habits and mode of life vie with the pilgrim to Mecca. Some curious facts which have come to our knowledge suggest a word of caution on this point to the heads of households and parents of families, who are careful enough of their own lives, but forget an ever-present peril to which they are exposed by contact with the *stranger* within their gates. There is an obvious remedy for this evil, and scrutiny might, perhaps, lead to startling disclosures. In one case that has just been brought to our notice, and which suggested these remarks, it was accidentally discovered that a female cook, in a respectable family, had not, to the knowledge of her fellow servants, occupiers of the same rooms, changed her clothes for a whole month!—*Lancet.*

ALDERS FOR THE LAWN.

UNFORTUNATELY for the beauty of our lawns, we continue to neglect, without sufficient cause, entire genera of hardy and attractive plants. When asked, however, to explain this neglect, I confess I am at a loss. A plant too often attains undue popularity, because in this age of unlimited puff, it happens to suit a nurseryman to puff it. In this way, perhaps, as much as any other, a few genera or species come to occupy exclusively a great majority of lawns. Positively our lawns are poverty stricken, because we fail to use a really vast store of lawn-planting material ready at hand. Note, for instance, these very alders to which I desire to call your attention. Here is a whole genus of choice and valuable plants, having a great fitness for many purposes of lawn planting. How have they fared in the way of application? One or two varieties have made some noise in the world, but generally nurseries sell very few, considering their intrinsic value. Though fitted for most places, they like to dwell in moist ground on the margin of pools and streams, where their bright green foliage contrasts with the white and gray green of taller birches. Alders are sometimes trees, but more often shrubs. They mass well on outer boundaries as windbreaks, or as foils for the beauty of other trees. Some species and varieties are suited only for

such masses, while others merit distinguished isolated positions. As usual, the plebeian kinds preponderate.

Most distinguished, if not best, is the cut-leaved imperial alder, *Alnus glutinosa* (or *imperialis*) *laciniata*, the charms of which have almost received their due need of attention, considering that near relatives have been so neglected. It is unquestionably an elegant tree; cut leaved, vigorous, and refined in contour, and of good size withal. Many soils suit it admirably, especially in the interior of the country; but in sandy, dry soil, it often loses its luster of foliage during summer. *A. glutinosa*, the common European alder, is not specially superior on the lawn to our common American alder, *A. serrulata*. Some of its varieties are very beautiful, notably, *A. glutinosa aurea*. Like many golden and variegated varieties, the golden alder has not, in all cases, proved as enduring, summer and winter, as its parent. The *A. glutinosa* also presents other peculiar forms, such as the distinct oak-leaved and thorn-leaved kinds (*A. glutinosa quercifolia* and *A. glutinosa oxyacanthafo'ia*). I will only say of these kinds that they are worthy of their distinguished connections. The Japanese alders are specially fine, with tree-like habit, conspicuous fruit, and rich, shining green foliage, retained late in fall. Among alders they are hardly to be surpassed as ornamental plants.

Up to this point, all kinds of alders mentioned have been conspicuous for distinct ornamental qualities, fitted to distinguish them in isolated positions on the lawn. I would not rank them as high, ornamentally considered, as their relatives the birches, but they form, nevertheless, lawn-planting material of excellent quality. Japanese alders illustrate conspicuously the close likeness to each other borne by many Eastern, Asian, and American plants. For instance, in Japan and along the Amoor River, we hear of *Alnus incana hirsuta*, and an *A. viridis*, almost identical with our own species of the same names. Passing to the more common, though equally worthy kinds, we come to the mountain alder (*A. viridis*, a somewhat inconspicuous species; the common American alder (*A. serrulata*), and the speckled alder (*A. incana*), all, be it noted, American species. The effect of these varieties of alder in mass (as they should be) on the lawn is not notably different, one from another, from a lawn-planting standpoint. One, *A. incana*, has the most distinct grayish spots on the reddish-brown or bottle-green stems and leaves, which are never downy, but specially shining. Another, *A. serrulata*, is perhaps the best, because the most generally successful under all conditions. This species, on the other hand, has downy young leaves and foliage noticeable for blunt or rounded points. Other species have usually acute leaves. One variety of *A. incana*, called *glauca*, is more blue on the under side of the leaf than others. There are also dwarf varieties of *incana* and other species. *Alnus cordifolia*, native and common in Italy and the south of France, is hardy, but in the character of lawn plant it does not differ remarkably from other alders.

All alders have alike gray, curious looking bark and shining green foliage, and at least in two cases—that one great charm of alders—golden purple tassels two or three inches long. These are warmed into life by the earliest breath of spring, and present special charms amid the yet dormant foliage of that season. They were formed in the fall, and seem only to await a prolonged breath from the south to hang out their small banners as a glad harbinger of settled spring. Later on, the flowers appear, but these in several species, are inconspicuous. Early spring is the heyday of the alder's beauty. Alders should be used in quantities along the banks of streams and pools, where their vigorous roots help to retain solid lands in spots most liable to cave. How ornamental, too, the low waving green foliage of alders thus situated, as their course follows that of the stream through long stretches of green and level meadow!

In connection with alders, I should like to say a word about certain species of winterberries or black alders, *Prinos verticillata*, *P. lævigata*, etc. Properly classified, they are hollies; but, never mind, they look like alders and are unfairly neglected—two qualities which give them an equal claim with the alders on our attention. *P. verticillata* is a handsome shrub, usually six to eight feet high, with thickly crowded branches and shining leaves, which are acute at both ends, and the wood of growths of different ages passes from bright green to pearl green, and so into still darker tints. It is a clean, thrifty, shining shrub, doing well in upland, but still better in moist spots. Its crowning beauty, however, is its crop of orange-scarlet berries, retained throughout the autumn quite into winter. Numerous white flowers in June lend it a later charm. *P. lævigata* is another species, bearing, if possible, brighter berries, which are retained even throughout the winter. The leaves are very shining. *P. glabra* is evergreen and American, but is less hardy and otherwise valuable. This is a brief consideration of the lawn-planting qualities of alders, but in one sense it is enough. It must be certainly evident that the lawn planter is sadly neglecting his opportunities when he fails to employ such excellent lawn-planting material as the alders. —*S. Parsons, Jr., in Country Gentleman.*

[Continued from SUPPLEMENT No. 235, page 3750.]

FOREST TREES OF NORTH AMERICA.

By CHARLES S. SARGENT, Arnold Professor of Arboriculture in Harvard College, Special Agent Tenth Census.

300. *Tsuga mertensiana*, Carrière. *Pinus mertensiana*, Bong. *Abies mertensiana*, Lindl. *Abies Albertiana*, Murr. *Abies bridgesii*, Kellogg. In the coast regions, from Alaska south to Mendocino and Marin counties, California. Wood less coarse and straighter grained than in the last species. A tree, 100 to 200 feet in height.

301. *Tsuga Pattoniana*, Engelm. *Abies Pattonii* or *Pattoniana*, Jeffrey. *Abies Hookeriana*, Murr. *Abies Williamsonii*, Newberry. *Pinus Pattoniana*, Parl. California and Oregon, "in the highest timber regions of the Sierra Nevada, at 8,000 to 10,000 feet altitude; from the head of the San Joaquin River, northward and through the Cascade Mountains, near Crescent City descending to near the coast. —Brewer." Engelm., Bot. Cal. ii. 121, ined. A large tree, 100 to 150 feet in height, with a trunk 2 to 4 feet in diameter, or at high elevations reduced to a low shrub.

302. *Picea alba*, Link. *Pinus alba*, Ait. *Abies alba*, Michx. (White Spruce. Single Spruce.) From about latitude 67½° north, south through British America to Northern Maine, the southern shores of Lake Superior, Northern Minnesota, and Dakota? Wood light-colored, lighter than that of the Black Spruce; preferred for the masts of boats, small spars, etc., but probably little used within the limits of the United States. A small tree, sometimes 50 feet in height, with a trunk rarely, if ever, exceeding 18 to 24 inches in diameter.

303. *Picea Engelmanni*, Engelm. *Abies nigra*, Engelm. [not Poir.] *Abies Engelmanni*, Parry. *Pinus commutata*, Parl. British Columbia and Oregon, south through the Rocky Mountains to Arizona (San Francisco Mountains, Sierra Blanca, Mount Graham), and east to the Black Hills of Dakota. Wood resembling that of the eastern Black Spruce. A large tree, with a trunk sometimes 2 to 3 feet in diameter, or above the timber line reduced to a prostrate shrub; in Colorado forming extensive forests at 8,500 to 11,500 feet elevation, and furnishing the most valuable timber of the central Rocky Mountain region.

304. *Picea nigra*, Link. *Pinus nigra*, Ait. *Abies nigra*, Michx. *Pinus rubra*, Lamb. *Abies rubra*, Poir. *Abies nigra*, var. *rubra*, Michx. f. *P. rubra*, Link. Newfoundland, Nova Scotia, and Canada; through the Northern States, from Maine to Wisconsin, and south along the Alleghany Mountains to the high peaks of North Carolina. Wood light-colored or reddish, light, elastic, strong; largely sawn into boards and square timber; formerly somewhat used in ship-building, for spars, etc.; also now largely employed in the manufacture of paper. The Spruce lumber of the eastern markets is derived from this species. A small or medium-sized tree, 50 to 70 feet in height, with a trunk 2 to 3 feet in diameter: in high mountain woods; sometimes in cold, deep swamps, when it is small, stunted, and of little value.

305. *Picea pungens*, Engelm. *Abies Menziesii* of Colorado botanists. Rocky Mountains of Colorado, extending into Wyoming and perhaps Idaho. A large tree, 100 to 150 feet in height, with a trunk 2 to 3 feet in diameter; at 6,000 to 8,500 feet elevation; never forming forests, but scattered along streams, in damp, moist soil.

306. *Picea sitchensis*, Carrière. *Pinus sitchensis*, Bong. *Pinus menziesii*, Dougl. *Abies menziesii*, Lindl. Alaska, south to Mendocino County, California, near the coast, and east to? Wood light-colored, straight-grained, valuable; resembling and probably surpassing that of the eastern Black Spruce. A tree, 150 to 200 feet in height, with a trunk 6 to 9 feet in diameter; in wet, sandy soil, generally near the mouths of streams. Rare. Its range to the east still uncertain. A peculiar Spruce should be looked for in Strawberry Valley and other valleys and slopes about Mount Shasta, California, at 3,500 to 4,000 feet elevation; about which nothing is known but "that its lower branches are very long, slender, and handsome, and its leaves much narrower than those of *P. sitchensis;* 7 to 9 lines long, and two-thirds of a line wide, quite obtuse, strongly keeled, and stomatose on the upper side and without stomata beneath."—Engelm., Bot. Cal. ii. 123, ined.

307. *Larix Americana*, Michx. *Pinus pendula*, Ait. *L. pendula*, Salisb. *L. macrocarpa*, Forbes. *L. intermedia*, Lodd. *Pinus macrocarpa*, Lamb. (American Larch. Black Larch. Tamarack. Hackmatac.) Latitude 65° north, south through British America; in the Northern States from Maine to Wisconsin, and south to the mountains of Pennsylvania. Wood light-colored, strong very durable; extensively used and preferred for the upper knees of ships, and for posts, railway ties, etc. In Labrador and Newfoundland, a tree 80 to 100 feet in height, with a trunk sometimes 2 to 3 feet in diameter; on moist uplands or interval lands; within the limits of the United States, smaller, less valuable, and always in cold, damp swamps.

308. *Larix Lyallii*, Parl. *Pinus Lyallii*, Parl. Oregon, in the Cascade and Galton ranges, at 6,000 to 7,000 feet elevation. A small and little-known tree.

309. *Larix occidentalis*, Nutt. *L. Americana*, var. *brevifolia*, Carrière. *Pinus Nuttallii*, Parl. Oregon and Washington Territory, in the Cascade Mountains up to 5,000 feet elevation, and eastward to the western slopes of the Rocky Mountains. A little-known tree, said to attain a height of 150 feet, with a trunk 2 to 3 feet in diameter.

310. *Pinus Arizonica*, Engelm. Wheeler's Rep. vi. 260. On the Santa Rita Mountain, Southern Arizona. "The best lumber of that region; there called Yellow Pine."—Rothrock. A little-known tree, 40 feet in height, with a trunk 2 to 3 feet in diameter; only collected by Dr. Rothrock in 1874.

311. *Pinus Australis*, Michx. *P. palustris*, Mill. (Long-leaved Pine. Southern Pine. Georgia Pine. Brown Pine. Yellow Pine. Hard Pine.) Southern Virginia to Florida and Mississippi, Louisiana, in the Valley of the Red River, and probably in Eastern Texas; not extending more than 100 miles from the coast. Wood superior to that of any other North American Pine; strong, compact, straight-grained, remarkably free from sap wood, very durable; largely employed in construction of all sorts, ship-building, and for fencing, railway ties, etc. From this species nearly all the turpentine, tar, pitch, and rosin produced in the United States is derived. A tree of the first economic value, 60 to 80 feet in height, with a trunk 2 to 4 feet in diameter; in dry, sandy soil, or more rarely in low swamps.

312. *Pinus Balfouriana*, Jeffrey. (Fox-tail Pine. Hickory Pine.) California, in the Mount Shasta region, on the flanks of Scott Mountain, at 5,000 to 8,000 feet elevation, forming an extensive forest (Lemmon); on Mount Whitney and on the head waters of King and Kerr Rivers. A medium-sized tree, rarely exceeding 50 feet in height, with a trunk sometimes 5 feet in diameter.

Var. aristata, Engelm., Bot. Cal. ii. 125, ined. (*Pinus aristata*, Engelm. Am. Jour. Sci., 2 ser., xxxiv. 332, and Trans. Acad. St. Louis, ii. 205, t. 5, 6.) Mountains of Southeastern California; on the high mountains through Nevada, Northern Arizona, and Southern Utah to Colorado, above 7,500 feet, and in Colorado reaching 12,000 feet elevation. Wood reddish, close-grained, tough, very strong; in Central Nevada preferred for the timbering of mines. A tree, 50 to 100 feet in height.

313. *Pinus Banksiana*, Lamb. *P. Hudsonica*, Poir. *P. rupestris*, Michx. f. (Scrub Pine. Gray Pine.) From latitude 65° north, south through British America to the northern borders of Maine, Michigan, Wisconsin; and in Minnesota and Dakota? Wood hard, very resinous, of little value; in New Brunswick somewhat used for railway ties. A low shrub or tree, rarely exceeding 20 feet in height.

314. *Pinus Chihuahuana*, Engelm. Sanoita Valley, Southern Arizona, at 6,500 feet elevation, and common in Western Chihuahua. A tree, 30 to 50 feet in height.

315. *Pinus contorta*, Dougl. *P. inops*, Bong. Veg. Sitch. 45. *P. Bolanderi*, Parl. in DC. Prodr. xvi 2 379. Alaska, south to Mendocino County, California, near the coast. A small tree, 5 to 25 feet in height, with a trunk rarely exceeding 6 inches in diameter; in wet, sandy soil.

Var. Murrayana, Engelm. Bot. Cal. ii. 126, ined. *P. contorta*, Newberry, Pacif. R. Rep. iv. 34, t. 5, and of the Californian botanists. *P. inops*, Benth. Pl. Hartw. *P. Murrayana*, Murr. *P. contorta*, var. *latifolia*, Engelm. in Bot. King Rep. vi. 331, etc. Oregon, in the Cascade Mountains; common in the high Sierras of California where, at an elevation of 8,000 to 9,000 feet, it forms extensive forests; in the Rocky Mountains of Colorado and Southern Utah. Wood white, very light, straight-grained, valuable. A tree, 60 to 80 feet in height, with a trunk 2 to 4 feet in diameter.

316. *Pinus Coulteri*, Don. *P. macrocarpa*, Lindl. California, in the coast ranges, from Monte Diablo south to the southern border of the State. Wood said to be brittle. A tree, 50 to 70 feet in height, with a trunk 1 to 2 feet in diameter.

317. *Pinus edulis*, Engelm. (Piñon. Nut Pine.) Cañon City, Colorado, south through New Mexico and Arizona. Wood supplying a valuable fuel. A small tree, rarely reaching 30 feet in height, with a trunk 8 to 12 inches in diameter; the large edible seeds furnishing to the Indians a valuable article of food.

318. *Pinus Elliottii*, Engelm. ined. South Carolina, to Florida and Southern Alabama, near the coast. A large tree, probably often confounded with *P. taeda*.

319. *Pinus flexilis*, James. (White Pine.) In the Rocky Mountains, from Montana to New Mexico; on the high mountain ranges of Nevada (above 8,000 feet elevation), Arizona, and on the Inyo Mountains and Mount Silliman, California. Wood white, soft, and, although not free from knots, of fair quality; intermediate between eastern white pine and sugar pine. A tree, 50 to 60 feet in height, with a trunk 2 to 4 feet in diameter; the most valuable timber tree of Central Nevada, where it is sawn into boards.

Var. albicaulis, Engelm. Bot. Cal. ii. 124, ined. *P. albicaulis*, Engelm. *P. cembroides*, Newberry. *P. shasta*, Carrière. Montana, British Columbia, and on the Alpine peaks of the Sierra Nevada, from Mount Shasta to Mono Pass, and in the Scott Mountains, California. A tree, 40 to 50 feet in height, or at the highest elevations reduced to a low shrub.

320. *Pinus glabra*, Walt. (Spruce Pine.) South Carolina, to Florida and Mississippi, near the coast. Wood soft and white. A tree, 40 to 60 feet in height, with a trunk 12 to 18 inches in diameter; in swampy soil. Rare.

321. *Pinus inops*, Ait. (Jersey Pine. Scrub Pine.) Middle Island, Long Island, Tottenville, and Clifton, Staten Island, New York, south to Cedar Keys, Florida, and from Kentucky to Arkansas—Nuttall. Wood probably of little value, except as inferior fuel. A small tree, 10 to 40 feet in height, with a trunk rarely 2 feet in diameter; in sterile, sandy soil; springing up everywhere on the abandoned tobacco lands of Virginia and North Carolina. A variety with serotinous cones (*P. clausa* and *P. inops*, var. *clausa*, Chap.) has been detected in Florida by Dr. Chapman.

322. *Pinus insignis*, Dougl. *P. Californica*, Lois? *P. adunca*, Bosc. *P. radiata*, Don [not Gordon]. (Monterey Pine.) Sea coast of California, from Pescadero south to Monterey and San Simeon Bay. A tree, 80 to 100 feet in height, with a trunk 2 to 3 feet in diameter.

323. *Pinus Lambertiana*, Dougl. (Sugar Pine.) California, on the coast ranges, from the Santa Lucia mountains north to Humboldt County, along the Sierra Nevada throughout the length of the State, especially on the western flank, at 4,000 to 8,000 feet elevation; and in the Cascade Mountains of Oregon north to the Columbia River. Wood resembling that of the eastern white pine, but heavier, stronger, coarser grained, and probably less easily worked. A tree, 150 to 200 feet in height, with a trunk 10 to 20 feet in diameter.

324. *Pinus mitis*, Michx. *P. variabilis*, Pursh. (Yellow Pine. Short-leaved Pine. Spruce Pine.) Gifford's, Staten Island (a single specimen), south to Florida and Tallapoosa County, Alabama; on the Ozark Mountains of Missouri, where it is the only Pine, and south into Arkansas; doubtless in many intermediate stations. Wood yellow, hard, compact, durable; inferior to, although employed for the same purpose as that of *P. australis*. A tree, 40 to 70 feet in height, with a trunk rarely 2 feet in diameter.

325. *Pinus monophylla*, Torr. and Frem. *P. Fremontiana*, Endl. (Nut Pine.) Through Central Nevada, Southern Utah, and Arizona; along the eastern slope of Sierra Nevada; and in the Californian coast ranges about Fort Tejon. Wood white, soft, very resinous, furnishing valuable fuel; and in Central Nevada, where it will soon be exterminated, largely made into charcoal. A small bushy tree, 10 to 20 feet in height, with a trunk sometimes 2 feet in diameter; the large edible seeds invaluable to the Indians of the "Great Basin," and their principal article of food.

326. *Pinus monticola*, Dougl. Washington Territory and Oregon in the Cascade Mountains, and south along the Sierra Nevada to Calaveras County, California, at 7,000 to 10,000 feet elevation. Wood said to resemble that of the eastern white pine. A tree, 60 to 80 feet in height, with a trunk 2 to 3 feet in diameter.

327. *Pinus muricata*, Don. *P. Edgariana*, Hartw. California, "only near the coast, where it is exposed to the sea winds and fogs, to an altitude of 2,000 feet from Mendocino, where it grows tallest (in peat bogs), to Tomalis Point (in the most sterile soil), Monterey and San Luis Obispo."—Engelm. Bot. Cal. ii. 128, ined. A slender tree, 25 to 50, or rarely 80 to 120 feet in height, with a trunk 1 to 3 feet in diameter.

328. *Pinus Parryana*, Engelm. *P. llavcana*, Torr. Only collected by Dr. C. C. Parry, 40 miles southeast of San Diego, California, and beyond the limits of the United States, to which, however, it may yet perhaps be found to extend. A small tree, 20 to 30 feet in height, with a trunk 10 to 18 inches in diameter.

329. *Pinus ponderosa*, Dougl. *P. Benthamiana*, Hartw. *P. Beardsleyi*, Murr. *P. Craigana*, Murr. (Yellow Pine.) Throughout Oregon and California, especially along the western slopes of the Sierra Nevada. Wood yellow, hard, heavy, strong, durable, very valuable. A large tree, 200 to 300 feet in height, with a trunk 12 to 15 feet in diameter: with its varieties the most widely distributed (not yet seen on any of the mountain ranges of Nevada), and the most valuable of the western pines.

Var. Jeffreyi, Engelm Bot. Cal. ii. 120, ined. *P. Jeffreyi*, Murr. *P. deflexa*, Torr. in part. Oregon and California, principally along the eastern slopes of the Sierra Nevada, above 5,000 feet elevation. A tree, 100 to 200 feet in height, with a trunk 10 to 15 feet in diameter; often in the most arid situations.

Var. scopulorum, Engelm. l. c. (*P. ponderosa* of the Colorado botanists). Throughout the Rocky Mountains from British Columbia to New Mexico and Arizona. A tree, 80 to 100 feet in height.

330. *Pinus pungens*, Michx. (Table Mountain Pine.) In the Alleghany Mountains, from Pennsylvania (Port Clinton, Harrisburg, etc.) to North Carolina. A small tree, 30 to 50 feet in height, with a trunk 18 to 20 inches in diameter. Rare.

331. *Pinus resinosa*, Ait. *P. rubra*, Michx. f. (Red Pine. Norway Pine.) From about latitude 50° north, south through the extreme northern and New England States to the mountains of Pennsylvania, and west to Minnesota. Wood light-colored, resinous, hard, heavy, durable; employed in construction, ship-building, etc. A tree, 60 to 80 feet in height, or in Michigan 100 to 150 feet in height (Bessey), with a trunk 2 to 3 feet in diameter; in light sandy soil. Nowhere very common; forming scattered groves, rarely exceeding a few hundred acres in extent.

332. *Pinus rigida*, Mill. (Pitch Pine.) Mount Desert, Maine, and Northern Vermont to the upper districts of Georgia, not extending west of the Alleghany Mountain region. Wood heavy, resinous, or when grown in low ground soft and largely composed of sap wood; little used except as fuel, although sometimes sawed into cheap boards. A tree, 40 to 80 feet in height, with a trunk sometimes 30 inches in diameter; in the driest and most barren, sandy soil, or in deep swamps.

333. *Pinus Sabiana*, Dougl. California, throughout the coast ranges; on the foothills of the Sierra Nevada, up to 4,000 feet elevation, and in the valley of the Sacramento River; east of the Sierras only seen in Owens's Valley. A small tree, 40 to 50 feet in height, with a trunk rarely exceeding 2 feet in diameter; the edible seeds supplying the Indians with a valuable article of food.

334. *Pinus serotina*, Michx. *P. tæda*, var. *alopecuroidea*, Ait. Hort. Kew. (Pond Pine.) North Carolina, to Middle Florida, near the coast. A tree, 40 to 80 feet in height, with a trunk rarely exceeding 20 inches in diameter; in low, swampy, peaty soil.

335. *Pinus strobus*, L. (White Pine. Weymouth Pine.) Newfoundland, the northern shores of Lake Nipigon and the Saskatchewan; south through the New England and Northern States, and along the Alleghany Mountains to Georgia. Wood white, soft, clear, free of knots; easily worked, and susceptible of a beautiful polish; durable when not placed in contact with the soil, although lacking in strength; immense quantities of boards annually sawed from this species are used for the outside covering of buildings, packing cases, cabinet work, and many domestic purposes. A tree, 80 to 150 feet in height, with a trunk sometimes, though rarely, exceeding 4 feet in diameter.

336. *Pinus tæda*, L. (Loblolly Pine. Old Field Pine.) Southern Delaware and Fredericksburg, Virginia, to Florida, Alabama, Eastern Texas, and in Arkansas. Wood "sappy, coarse-grained, liable to warp and shrink, and soon decays on exposure." A tree, 50 to 70 feet in height, with a trunk 2 to 3 feet in diameter; in low, moist situations, where it reaches its greatest development, or in dry, sandy soil; everywhere springing up in abandoned lands near the coast in the Southern Atlantic and Gulf States. Turpentine of inferior quality is produced from this species. In the vicinity of Albemarle Sound, in low, swampy districts, the Loblolly Pine is said to occasionally attain a height of 150 to 170 feet, and to produce timber of great value, and is there locally known as "Swamp Pine," "Slash Pine," "Rosemary Pine."

337. *Pinus tuberculata*, Gordon. *P. Californica*, Hartw. California, from the Shasta region through the coast ranges to San Bernardino and the Santa Lucia Mountains, and on the foothills of the Sierra Nevada at 2,500 feet elevation, near Forest Hills, Placer County (Bolander). A small tree or bush, 3 to 20 or rarely 40 feet in height.

PAYMACEÆ.

338. *Sabal palmetto*, R. S. *Chamærops palmetto*, Michx. (Cabbage Tree. Cabbage Palmetto.) North Carolina (rare), and south to Florida, near the coast. Wood porous, resisting the attacks of the Teredo, and almost imperishable under water; highly valued for piles, wharfs, etc. A tree, 20 to 40 feet in height.

339. *Washingtonia filifera*, Wendl. Bot. Zeit. xxxvii. 68. *Brahea dulcis* (?), Cooper, Smith. Rep. 1860, 442. *Brahea filamentosa*, Hort. *Pritchardia filamentosa*, Wendl. San Bernardino County, California, to Western Arizona. A tree, 20 to 40 feet in height, with a trunk sometimes 2 to 3 feet in diameter; "in rocky localities, in dry sheltered cañons, solitary, or few in a group."—Watson, in Bot. Cal. ii. 211, ined. Some other species, as yet very imperfectly known, possibly occur in Southern California.

340. *Thrinax parviflora*, Sw. "Keys along the Florida reefs, extending up the west coast as far as Cape Rowano."—Chapman, in Coult. Bot. Gaz. iii. 12. A small tree, 10 to 30 feet in height.

LILIACEÆ.

341. *Yucca brevifolia*, Engelm. *Y. draconis?* var. *arborescens*, Torr. Southwestern Utah, Northwestern Arizona to Southern Nevada, and Southeastern California; forming near the Mohave River, on the desert plateau, at 2,000 to 4,000 feet elevation, straggling forests. Wood, as in the whole genus, brittle and fibrous. A small tree, 15 to 30 feet in height, with a trunk often 2 feet in diameter.

342. *Yucca treculiana*, Carrière. Southern Texas, Matagorda Bay, and from the Brazos and Guadaloupe Rivers south into Mexico. A small tree, 15 to 25 feet in height, with a trunk 1 to 2 feet in diameter; the bitter-sweetish fruit cooked and eaten by the Indians.

A QUICK TEST FOR ALOES.

The presence of aloes in beer, liquors, or extracts can be determined, says Borntræger, by shaking the liquid with twice its volume of benzol (coal tar), decanting the benzol, which may have a faint yellowish green color, and adding a few drops of ammonia. If aloes are present the ammonia acquires a beautiful purple color, especially on warming it slightly. The addition of an acid destroys the color, which, of course, returns on adding an alkali. The reaction is so delicate as to detect 1 part in 5,000 in five minutes. If much aloes are present a precipitate is formed with a chloride of iron solution.—*Zeit. Anal. Chem.*

UNSEEN ENEMIES.

A LECTURE was recently given in London by Professor Ray Lankester, F.R.S., on "Germs—Unseen Enemies." The rooms, as on previous occasions, were crowded. Professor Lankester, commencing with the simplest description of germs, as observed in growing plants, and such minute organisms as are found proving their existence by seeming spontaneous growth on any exposed surface of earth or other suitable medium for their development, described with graphic power the principles of fermentations, not only those which are associated with the production of alcohol and acetic acid, but also those peculiar influences which are connected with the decay of animal and vegetable life. The various forms assumed by the *vibrio*, with the important facts of their growth and multiplication, were demonstrated by diagram, and shown also microscopically, while the methods that can be adopted for their destruction were also dwelt upon. It seemed, he said, that heat is a certain destroyer of all germs, if it be of long continuance and of sufficient degree. Boiling is an undoubted means of effectually "sterilizing" all *vibrios*; and in some very practical and laudatory remarks on the antiseptic views of Professor Lister, Mr. Lankester stated that a solution of carbolic acid, one in twenty, will, if it be brought thoroughly into contact with germs, at once render them inert. The classification of these "unseen enemies" was, he allowed, not very perfect. It was at present only based upon the effects produced rather than on any special variety in their growth or appearance. Three varieties were described—namely: those producing odors, those producing colored products without odor, and those recognized as disease-producing germs. All bad smells, except those arising from chemical works and their products, were, he stated, due to the presence of *vibrios*. The lecturer rather startled the audience by assuring them that the flavor of cheese merely depended upon the presence of some of these germs, but the minds of his hearers were set at rest when assured that both the odorous and color-producing *vibrios* were harmless, and therefore did not need any precautions further than acting as a warning to remove as far as possible bad smells and disagreeable flavors. With regard to the disease-producing varieties Professor Lankester stated that it was yet quite a matter of doubt whether (with the exception of two diseases—malignant pustule and splenic fever) the presence of the particular form of bacteria caused the disease, or whether it was not merely associated with the condition of the patient and the debilitated state of the system generally. The Professor, in the course of his lecture, suggested that it would be profitable, in the best sense, to establish laboratories and suitable opportunities for prosecuting original scientific research by competent professors into the many wide and important questions associated with the subject of the presence of unseen enemies in the daily life of our population.

MAN PREHISTORIC, PRESENT, AND FUTURE.

THE Rede lecture was lately delivered at Cambridge, Eng., by Dr. Humphry, F.R.S., Professor of Anatomy. Professor Humphry explained that the differences between men and other animals consist in the proportions and relations to one another of the several parts of the body, more particularly in the balancing of the head and trunk upon the lower limbs, the size of the lower limbs, the size of the brain, and the repression of the jaws. After pointing out some of the chief differences which are observed at different periods of life and in different nations, Dr. Humphry exhibited and described the crania of the earliest known inhabitants of this island, pre-Celtic and Celtic, the collection of which, obtained by Dr. Thurnam from the long and round barrows in South Wiltshire, is now in the Cambridge Anatomical Museum. Dr. Humphry demonstrated that these skulls of the earliest inhabitants, so far from showing approximation to the brute, were, on the contrary, refined, well proportioned, with their brain cavity larger than the average of modern Europeans, and were marked on the interior in such a manner as to indicate that the brain convolutions were as numerous. The proportions and conformation of the other bones of the skeleton did not show any sign of degradation. These early skeletons showed that the earlier of the two races, who used stone implements of the later type, were men of short stature, with heads elongated from front to back. These people were supposed to have been widely spread over Europe before the Aryan migrations and now represented by the Basques. They had left their traces among the people of the Midland counties, Wales, and Ireland. The members of the latter or Celtic race were of larger stature and with rounder heads. The bones obtained from caves in other parts of this country, as well as from older caves on the Continent, from Engis Neanderthal, south of France, and Italy, all told a like tale of ample brain space, good formation of limbs, and of unquestionable human character. Some of these people were undoubtedly coeval with the mammoth, approaching, therefore, to the glacial period and perhaps beyond. Professor Humphry next commented upon the inferences to be drawn from the different forms of the skull and the brain. Strong as was the probability that the appearance of man upon earth was the result of some great law of evolution, by which the varied living forms were produced and regulated, yet our knowledge of that law was yet in its infancy, and a vast amount of investigation must be carried out after the careful philosophic method of Mr. Darwin before we ought to dogmatize upon it. The geological record had hitherto given no indications of the evolution of man, and it was scarcely to be expected that they would now be found in the northern hemisphere. Perhaps the bowels of the earth beneath the dry land or beneath the oceans of the southern regions, where man shows a somewhat nearer approach to lower forms, may yield information on the subject. The correlation of the physical and mental powers was next dwelt upon, and the Professor urged the importance of maintaining a vigorous physique as the basis of good mental power, especially since the advance of civilization tended to the greater subdivision of labor with concentration of attention upon limited areas, which, together with the preservation of the weak and sickly, would infallibly lead to degeneration unless counteracted by intermingling of breeds and by efficient sanitary measures. It was to the blending of so many bloods with so many attendant influences—pre-Celtic, Celtic, Roman, Saxon, Danish, and Norman—upon a land of great natural advantages and resources, with a climate favorable to the body and stimulating to the energies by its uncertainty, that the men of Britain had owed their ability to attain so prominent a place in the history of our race. Speaking of the importance of the introduction of sanitary legislation, Dr. Humphry said that herein lay the most important work of the future, and he spoke of the necessity of a fuller and more general apprehension of the laws of health, and of a clear appreciation of the interdependence of the intellectual, the moral, and the physical states of man. Upon this depended the future welfare and happiness and progress of our race. They must not suppose that good would be done by any narrow-minded attempt at shutting off one article of food or totally abstaining from another. "Variety of diet," he said, "is one of the factors in man's physical improvement as well as variety in blood and variety in occupation. What is needed is that moderation in all things which is true temperance and the true trial of man. Few things would tend to the improvement of the race so much as judicious arrangements with regard to matrimonial selection. I am not aware that any such arrangements have ever been seriously contemplated, and the time is not yet ripe for them; but I cannot doubt that something in this direction will be done when the attention of the people and their legislators has been sufficiently aroused to the importance of providing for a healthful race in future." Professor Humphry concluded a lecture which lasted upwards of an hour as follows: After all, to the burning questions Whence? and Where?—whence comest thou, O man, and whither goest thou?—to which it might have been expected by those who do not fully know their difficulties that I should make—as regards the body at least—some answer, I am compelled to reply that we find ourselves simply floating on the streams of time. Sufficient for the day must be the knowledge thereof. Whether we peer fore and aft, it is obscurity. We are still children crying in the night, children crying for the light and with no language but a cry."

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